Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LV. NEW YORK, THURSDAY, JUNE 2, 1910. No. 22.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK

JAMES H. McGRAW, President.
HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITOR.....W. D. WEAVER
A. S. M'ALLISTER.....Associate Editor
W. H. ONKEN, JR.....Associate Editor
T. R. TALTAVALL.....Associate Editor
W. E. KEILY.....Associate Editor
O. A. KENYON.....Associate Editor
O. H. CALDWELL.....Assistant Editor
W. M. FINLEY.....News Editor
S. S. BOIES.....News Editor
FREDERIC NICHOLAS.....Special Contributor
J. R. CRAVATH.....Special Contributor

CHICAGO OFFICE.....1570 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

Copyright, 1910, by McGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The Circulation of Electrical World for 1909 *was* 945,850. *Of this issue* 24,000 *copies are printed.*

NEW YORK, THURSDAY, JUNE 2, 1910.

CONTENTS.

Editorial 1421
Johns Hopkins Course in Illuminating Engineering..... 1426
A. I. E. E. Annual Convention..... 1426
Expansion of Guanajuato Power & Electric Company..... 1427
Patent Laws 1427
Overhead Construction for Electric Railways..... 1427
Industrial Education 1428
Fire at Wilmington City Electric Company's Plant..... 1428
New York Public Service Commission News..... 1429
Convention of the National Electric Light Association..... 1430
Current News and Notes..... 1440
Housatonic River Hydroelectric Plants..... 1441
Hydroelectric Development on the Niobrara River..... 1442
Economical Small Electrical Plants. By W. H. Miller..... 1444
Motor-Generators for Meter Calibration..... 1446
Electric Spot Welding. By A. E. Buchenberg..... 1448
Problems in Transmission..... 1449
Abstracts of N. E. L. A. Papers and Discussions..... 1452
Letters on Practical Subjects..... 1476
Questions and Answers..... 1480
Customers' Accounts 1481
Rotary Converter Improves Station Load and Efficiency..... 1482
How a Central Station Secured a Large Contract..... 1482
An Electric Building..... 1484
Strap Iron Supports for Conduit. By G. S. Mason..... 1485
LETTERS TO THE EDITOR:
Meter Commutators. By John Gilmartin..... 1487
Rational Central-Station Rates. By H. C. Deffenbaugh..... 1487
Digest of Current Electrical Literature..... 1488
Book Review 1492
New Apparatus and Appliances..... 1492
N. E. L. A. Convention Echoes..... 1493
Industrial and Commercial News..... 1499
General News 1503
Weekly Record of Electrical Patents..... 1511

THE ELECTRIC LIGHT CONVENTION.

An organization which can gather over 2600 of its votaries on the west bank of the muddy Mississippi, must have offered some inducement for the many who took the journey over long distances. The fact that it was the twenty-fifth anniversary of the association may have caused some to make the pilgrimage; an excursion at the expense of the company may have been the incentive for a few, and an enthusiastic desire to be of some service to the industry doubtless impelled still others. At any rate the programme was long enough and diversified enough to cover everything, and he was not alive to the opportunity who turned his back on St. Louis without something added to his store of knowledge and with a stronger appreciation of the greatness of the industry of which he forms a part. One lesson of the convention is that the organization has developed faster than the methods for its handling. This, of course, will be remedied. The problem of how best to manage an organization which has almost doubled its membership in less than a year, does not admit of off-hand solution, and the experience gained at St. Louis will not have been lost on the present management. Discussion on most papers was lacking, so that ideas and suggestions of value which oftentimes constitute the greater value of a meeting were few and far between. General observation would tend to suggest that old-time sociability was even lacking; but this, if true, was doubtless owing to the large attendance and to simultaneous sessions which did not allow of old-time "mixing" with its advantages in the interchange of experiences and opinions. Whatever may be the judgment of the degree of success of the convention, it certainly will be regarded as a turning point in the life of the organization and the milestone of a new era in the electric lighting industry.

COURSE IN ILLUMINATING ENGINEERING.

As announced on another page, the Illuminating Engineering Society has made an arrangement with Johns Hopkins University whereby a course of 36 lectures on illuminating engineering will be delivered in Baltimore the coming October, under the joint auspices of the society and the university. As will be noted, a feature of the course which will greatly enhance its benefit is an opportunity for work in the laboratory, through which those in attendance may become acquainted with the various instruments and appliances related to the practice of the art, and attain at least an intelligent idea of their manipulation, upon which to base later a working knowledge. The society is to be highly congratulated upon this latter evidence of its live appreciation of opportunities for usefulness coupled with well-directed activity. Since its organization four years ago the body has made a remarkable record. Before that time there was no systematic art of illuminating engineering, and the scientific knowledge and data relating thereto was not only scat-

tered and largely inaccessible, but also mainly in a form not capable of practical application. Through the work of the society, a body of knowledge has been established and co-ordinated which to-day gives illuminating engineering a basis as broad as that of very many of the older branches of technical science.

There yet remained, however, a vagueness as to what departments of knowledge are properly embraced in the science and art of illuminating engineering. Moreover, the title of illuminating engineer has, in cases, been assumed on very slender qualifications, as, for instance, on the ability to locate intelligently lamp outlets and specify shade equipments. The situation, in fact, resembled that existing in the early years of electric lighting, before the body of knowledge constituting the branch of electrical engineering was systematized and co-ordinated, and when everyone having to do with electricity assumed the title of electrician. Of course, the simple evolutionary process acting through time would finally put the house in proper order, but time is now an element to be discounted whenever possible. By the establishment of the Johns Hopkins course of lectures, not only is the scope of knowledge embraced in the science and art defined and the co-ordination of the several branches indicated according to the best opinion of the day—thus advancing a desirable condition by perhaps years—but an opportunity is offered on almost nominal terms to practicing engineers to round out their conceptions of the science of illuminating engineering as a whole, and profit immediately from the instruction given in their specific line of work or in the indications that will be furnished for pursuing its study systematically. Naturally, a course covered in such a short period could not enter exhaustively into the various subjects; the design of the Johns Hopkins course is rather to set forth the fundamental principles and give a condensed outline of the science and art, to be filled in later with the aid of books and periodical literature that will be recommended by each lecturer. The selection of lecturers has been most happy, not only as to wide knowledge of the subjects with which they will deal, but also with respect to the eminent standing they have acquired for practical achievement in their various branches. The inspiration for better and harder work that should come from sitting under such teachers is in itself no small part of the value the course will impart.

THE GROWTH OF THE CENTRAL STATION.

We cannot pass by the proceedings of the St. Louis Convention without calling attention to the very interesting and far-sighted comment of Mr. Insull on the past quarter of a century of central-station work. The younger generation of engineers and station managers can hardly realize that when the Association was founded there were less than 100 public plants in the United States doing a general central-station business, 24 hours per day. The growth to the present 6000 or thereabouts has been startlingly rapid, but even more important has been that tendency, which Mr. Insull emphasizes and which his own station best exemplifies, toward widening the field of central-station activities. The fundamental difficulty with central-station operation of business is the regular demand for output, and Mr. Insull, perhaps more than anyone else, has worked toward the larger field that tends to equalize the load not only throughout the 24 hours but throughout the year. If the maximum load for lighting comes in one month, that for tramways in another and that for larger railway enterprises in still another, a union of these three activities must produce a profoundly beneficial effect on a station load; and if one could go even further and produce energy at a price which would enable it to be used in electrochemical industries and other special off-the-peak enterprises, the benefits would be still greater. It is toward these large things that Mr. Insull's address leads the art, and perhaps the most notable thing in it is his final comment on the relation of central-station operation to the public. For an industry to have reached a point where its managers are actually looking upon themselves as mere public officials whose duties are not only to their stockholders, but to the public on whose patronage their stockholders depend, is most significant. There are of course some still left who seem as Mr. Insull puts it, "to have had more concern for the profit of the moment and little or no concern for the permanency of the investment in the future." But thanks to the example of the larger minds of the industry, these reactionists are becoming fewer. We have been passing in this country through an evolutionary stage with reference to the activities of great corporations. It has been, and still is, a period of stress and trouble in which Governmental agencies have been compelled to take a hand; yet of late there are many captains of industry, who, like Mr. Insull, have come to recognize that they are building up permanent structures and cannot safely forget the necessities of the next generation in the prosperity of this. It is this larger view that will do more to simplify the relation between the public and the great aggregation of capital than any amount of preaching or legislation.

PROBLEMS OF ENERGY TRANSMISSION.

Mr. Buck's St. Louis Convention paper on this topic is the most illuminating which we have had the pleasure of seeing for a long time past. It deals with the concrete problem of practice on a large scale in a way that forces immediate attention. Mr. Buck's comments on modern line construction we especially commend to the consideration of engineers as pointing out some of the weak points of supposedly good recent practice. The steel tower line has become the favorite form of construction on large systems. Its advantages have been many times dwelt upon, but questions of strength and durability have sometimes been neglected. Mr. Buck's remarks on this point ought to be taken to heart, the fact being, as he states, that the question of depreciation due to corrosion, especially in very light towers, which often have been used for economy's sake, has not been at all settled. If the steel is set directly in the ground, it is very dubious whether the life of the tower will be any greater than that of a wooden pole. If set in concrete the life will be of course much longer, but the cost per tower may be doubled. Most towers at present in use have been derived from windmill practice, a good enough guide in some particulars, although construction has been reduced by keen competition to factors of safety not altogether desirable in important energy-transmission systems. Incidentally, Mr. Buck refers appreciatively to the Semenza or Italian practice of so designing mere carrying poles or towers that they will bend within their elastic limits, thus reducing the

strains on the line, while giving an economy of material not to be approximated by towers intended to be rigid under the maximum strains conceivable. In this arrangement suitable anchorage towers of greater stiffness are installed at intervals to which in the suspension insulator construction the wires may be made fast.

It is certainly true that the suspension insulator has put an entirely new appearance on high voltage power transmission. Above 60,000 volts even the best pin insulators have too small a factor of safety in bad weather, and when large enough to improve this condition, put very heavy strains on their supports. The suspension insulator on the other hand minimizes the strain on the supports and gives adequate insulation in all kinds of weather even up to and above 100,000 volts. Mr. Buck very justly remarks that at the present moment the difficulties of insulation are less with the line than with the lightning arresters, transformers and substation equipment when these extreme voltages are in use. With the very long-distance and very high-voltage transmissions now undertaken, the line capacity has at last become a serious matter. Its effect on regulation, particularly on the regulation of the generators, is at times very troublesome, and it looks very much as though the situation required artificial loading of the lines with distributed inductance in order to steady the conditions of the transmission line itself, irrespective of what may be going on at the receiving end. It may turn out that this can be very advantageously done in connection with the protection of the line by lightning arresters.

Lightning arrester progress is not as rapid as it might be although the electrolytic type promises very well. High-voltage lines on the whole suffer much less than low-voltage lines for the reason that the whole apparatus, in order to secure an adequate factor of safety in the insulation, is so well insulated that the chance of puncture from surges or casual lightning discharge has been very much reduced. So far as the surges are concerned, the rise in voltage is a positive benefit owing to the reduction of the current which determines the magnitude of the surges. Mr. Buck's comment on the guard wire that "the general opinion is that it is a benefit as a protection from lightning," is a very good one. That is just about the state of the case, for it has not yet been made evident that any amount of protection by guard wires will enable one to dispense with local means of protection against abnormal voltages.

The prediction of Mr. Buck that the largest field for future evolution in power transmission is toward high-voltage direct-current will be a shock to some of our readers. We have many times intimated in these columns that high-voltage direct-current must be taken seriously and it is gratifying to find so experienced an engineer standing squarely upon that viewpoint. True enough there must in this country be a great deal of development in machine design before the high-voltage direct-current method becomes generally available. Yet the simplification in line construction and particularly the simplification in station equipment aside from the generators, would be most noteworthy. At the present time the accessory apparatus, including the switchboard, in a large high-voltage plant is a very formidable item of expense and more troublesome in maintenance than all the rest of the generating plant. If a modern transmission station experiences a serious interruption of service, the chances are much more than even that the trouble is outside the generating apparatus.

CENTRAL-STATION RATES.

Although there has been much talk of changes in central station rates and rate systems owing to the introduction of the tungsten lamp, the fact remains that the number of such changes has been very small. It is true that in a few cases special schemes have been worked out, like the flat-rate residence lighting plan at Hartford, and flat rates for store and commercial lighting in a few other cities. Taken altogether the effect of the tungsten lamp has not been as detrimental to the central station as was feared, even at existing rates, which is due partly to the general desire for more light and partly to the taking on of additional business. Some fear, however, has been felt that the introduction of tungsten lamps with ductile filaments which will stand hard usage may cause trouble by reducing residence revenues, which are already so low as to be uncomfortably near the fixed cost for serving small consumers except where such business is handled in large quantities with many consumers per block. Looking at the matter broadly, it seems likely that the history of the introduction of the tungsten lamp for commercial lighting will be repeated in the residence field; and the loss of revenue due to the substitution of tungsten lamps for carbon filament lamps will, without doubt, be largely offset by increased use of light and heating appliances and in added consumers.

Mr. S. E. Doane in his paper on "High Efficiency Lamps," before the N. E. L. A. convention, devoted a considerable portion to the rate question. He presented an analysis of the cost of rendering service taken from a canvass of operating companies, by which it was shown that 30.3 per cent of the average cost was due to kw-hour or output expense; 55.1 per cent, fixed charges, caused by the consumers' maximum demand; and 14.6 per cent charges caused by the regular expense of the care of consumers, independent of their consumption or maximum demand. The general trend of Mr. Doane's paper was to indicate the desirability of higher readiness-to-serve and consumers' charges and lower kw-hour charges in our systems of rates. It is certainly true that such a plan if carried out would minimize any possible detrimental effect on central station profits from the introduction of tungsten lamps. Whether or not it is feasible for any company to put the plan in force depends in most cases on how far the readiness-to-serve method of charging is recognized in the existing rates of that company. The rate systems now in use may be broadly divided into two general classes—those which recognize the fixed charges connected with a consumer's installation, and those which do not. Under the first classification come the companies using the readiness-to-serve system, consisting of a certain charge per consumer, plus a certain charge per kilowatt connected, plus a low rate per kw-hour. It also includes companies which charge a high rate for a portion of the consumers' bills until a point is reached where the fixed charges connected with his service are more or less paid up, after which a lower rate is given. In the second class come the companies which either have a uniform rate per kw-hour regardless of the connected load or maximum demand, or a certain

rate per kw-hour which is discounted according to the number of kw-hours used wihout regard to connected load.

To the consumers of the latter class, Mr. Doane's paper should appeal as containing some excellent suggestions as to advisable changes in the system of rates, franchises permitting. To the former class, which already has certain fixed charges paid by the consumer in one form or another, Mr. Doane's paper suggests the possibility of increasing these fixed charges. While such an increase may be logical and equitable, there are certain reasons of policy, as stated by Mr. Alex. Dow in the discussion of the paper, why few companies will care to increase that portion of their charges, as it would, in effect, increase the bills of a considerable number of small consumers, and deter many "prospects" from taking electric service. The total effect on the gross revenue would be small, but the bad effect on public sentiment would doubtless be large, because of the number of people affected and of a feeling that the company was trying to oppress the smaller consumer. The implication is that it is therefore better to let some of the larger consumers pay for the losses on the small ones than to attempt to adjust rates exactly in an equitable manner. This is a principle that has been recognized by some companies, which have abolished minimum monthly bills. While the large minimum bill or readiness to serve charge is just, it is not correspondingly popular.

It may be noted as one of the interesting signs of the times that manufacturers of lamps and other appliances are taking more interest in central station rates than formerly, realizing, at last that on the rates depend the sales of their product. It is seldom realized how many dollars' worth of electrical apparatus are used on the premises of consumers for each kilowatt of station equipment. Therefore, as far as gross sales are concerned, the manufacturers of energy-consuming appliances should, in the aggregate be more interested in the development of central-station business than are the manufacturers of power-station and distributing apparatus.

HIGH-POTENTIAL LINE PHENOMENA.

The history of the definition of the term "high-potential line" constitutes in itself a history of the art of electric-energy transmission. In the early days of the incandescent lamp development, when efforts were being made to produce, in the laboratory at Menlo Park, a stable high-resistance carbon filament, Mr. Edison used to say: "If we could only secure a lamp for as much as 100 volts, we could see daylight ahead." But the 50-volt lamp had to be produced first, and then, by comparison, the 100-volt lamp became a great advance, and the 100-volt line a high-potential line. After a breathing interval at the first century mark, the cost of copper raised a premium on high voltage, and the three-wire system introduced the 220-volt high-potential line. In Europe, the five-wire system brought the 550-volt high-potential line into occasional use, and the 200-volt incandescent lamp, with a three-wire system, brought the 440-volt high-potential line into very general use. Here the procession headed by the incandescent lamp came to a standstill. No further advance could be made until the lamp was set aside.

The alternating-current transformer now came to the rescue. With its aid, the high-potential line of 1000 virtual volts came into regular use, the lamps being operated at either 50 or 100 volts through step-down transformers. The alternating-current motor, and the converter, enabled energy to be supplied from high-potential circuits. Year by year, the transmission distances increased, and the potential went up with them. About the year 1893, 2000-volt circuits were well established, but 30,000 volts as a possible goal was openly ridiculed. After 5-kilovolt pressure was attained, difficulties were met with in the line insulator. Some predicted that 10 kilovolts could never be reached, because no line insulator could ever support such a high potential. Nevertheless, after many trials, line insulators became improved, and potentials rose to 20 and 30 kilovolts. Then came the discovery of the corona, and its inevitable waste of energy. Some predicted that 50 kilovolts could never be reached, because the corona would absorb all the energy at so high a potential. Some high-tension line experiments made in Colorado were unfortunately interpreted to this effect until the classical work of Prof. H. J. Ryan showed the fallacy of the conclusions drawn from them. To-day we have potentials in service up to 100 kilovolts between wires without corona, and the end is not yet. Each rise of potential, of course, adds to the expense of the insulation. The limit of practicable line voltage does not seem to lie in the feasibility of insulating high potentials, but in economy of line-conductor plus line-insulator total cost. In other words, engineers are likely to stop raising the potential because the process does not pay, rather than because the process is impracticable.

The paper by Dr. C. P. Steinmetz on "High-Potential Line Phenomena," read before the St. Louis convention, and abstracted on page 1455, commences by briefly alluding to the above historical outline of the term and provisionally defines the term high-potential circuit as one in which capacity effects commence to obtrude prominently. In underground lines, 10 kilovolts is placed as the approximate dividing limit between low and high potential, from this standpoint, while in overhead lines 30 kilovolts is a corresponding limit. Above these limits of potential high-potential surges become a noticeable property of the lines. The paper goes on to describe the phenomena of surges over transmission lines in very simple and easily followed terms. The surge most dangerous, and difficult to encounter, is the recurrent surge, in which an alternating-current high-potential arc establishes itself at some weak point on the line, and allows the line to oscillate, like a long wireless telegraph antenna, across this arc. The remarkable fact transpires that surges are not dangerous phenomena in and of themselves. They are only dangerous when they are accompanied by excessive potentials. When studied in detail, every time a lamp is thrown on or off a transmission system, and whenever a switch in the system is closed or opened, there is a surge set up, although ordinarily only a comparatively minute surge. It is only when a short-circuit, or an arcing ground, or a lightning disturbance arrives, that the surges become violent. Even then, they differ but in degree, and not in kind, from the surges that are constantly skimming over the system on the occasion of the smallest accidental disturbance. An interesting reference is made in the paper to the effect of time upon the length of a jump spark in air. Thus, it is mentioned that when the time of applying high-potential across a needle gap is greatly reduced, the sparking

distance may be reduced to only one-tenth of its normal steady value. This shows that time, energy and perseverance are required to puncture air electrically. The hope is also held out that, at very high potentials, the corona itself will form a natural relief valve for surge excesses. This is harnessing the corona into a cheap form of surge arrester. It may be that the corona will prove a halo of blessing in disguise.

THE N. E. L. A. CONVENTION PROGRAM.

With 44 formal papers, 16 section committee reports calling for discussion, and three addresses dealing with important central-station matters, the St. Louis program of the National Electric Light Association was so loaded that one who went to the convention with the hope of obtaining a general view of the existing central-station situation was in the plight of the small boy who strives to take in every act of a three-ring circus. Seriously, is it not high time for a change of policy in the formulation of N. E. L. A. convention programs? That the evil of an overloaded program has not escaped the attention of the association is shown by the provision made several years ago for parallel sessions; but in one particular this only aggravated the situation through depriving the all-around central-station man of a chance to inform himself on all of the phases of central-station work presented at a convention. With the great extension of the membership of the association, the proportion of central-station men has vastly increased who are not specialists in a single department, but who have more or less direct interest in every line of central-station work. In support of this statement, it is merely necessary to point out that the association has now 850 member companies, or more than five times the total number of cities in the United States with a population of 30,000 or over. Formerly the body drew its membership almost entirely from the central stations in the latter class of cities, but now its membership is overwhelmingly from stations in cities and towns of a size necessitating an organization which in most cases includes but a single head to supervise every department of work. By such programs as have in recent years characterized N. E. L. A. conventions, men of this class are sacrificed to the interests of the larger central station, which can send from their staffs to the annual meetings a number of representatives, each to attend a given class of sessions.

Without doubt, the crowning success of the convention was the address of Mr. Samuel Insull; and though some of the applause with which it was greeted may have been a personal tribute to the undisputed leader of the American central-station industry, the great appeal of the address unquestionably lay in its treatment of the broad problems which confront the industry at the present moment. Those parts relating to public service regulation, policy toward the public, the commercial side of the central station, and the extension of central-station service far beyond prevailing limits, interested directly every man present, while everyone could not but have felt a greater pride in his business from the view given of the unbounded possibilities in store for the great organizations which head the industry. This address tended to bring into relief the inadequacy of treatment at convention sessions of some of the burning questions of the moment to the average central station, such as the tungsten lamp situation, central-station rates, gas competition and gas-producer gas-engine generation. With the exception of gas competition —which, by the way, appears to be a subject as much tabooed at N. E. L. A. conventions as if its programs were subject to approval by the gas interests—the other subjects were represented, at least in part, by papers, but each topic justified a complete session for its full discussion. Some of the committee reports were also, as usual, unsatisfactory, having more the character of compilations of undigested data, unaccompanied in cases by any analyses or conclusions. Analysis followed by definite expressions of opinion should be characteristic of such reports, not only because the specialists who form—or should form—the membership of the various committees are qualified for the task, but also because of the resulting stimulation of discussions on points that would thus be brought forward in concrete form. It may be added that the reports bear evidence that the patience of central stations is becoming exhausted at filling out annually a half-score or more formidable committee inquiry sheets, perhaps because of the unsatisfactory manner in which the data thus collected are utilized.

Possibly there is a policy behind N. E. L. A. programs beyond merely one to present a long array of papers on miscellaneous subjects which, in extent, will be at least impressive, and also make the printed *Transactions* correspond in volume with the yearly growth of the industry. Whatever may be the policy, it appears to be lacking in three essential elements, namely, in securing predominance of subjects of a timely character having interest to the largest proportion of the members of the association; in providing for adequate discussions, and in according opportunities to the all-around central-station man for covering all the sessions in which he is interested. None of these faults appears to be inherent to the formulation of a N. E. L. A. program, and it is to be hoped that an attempt will be made at their correction. For example, if several months prior to a convention each member were asked to specify what topics he wished to appear on the program as subjects of papers or for discussion, ideal guidance would be at hand for its formulation. Under such a plan manufacturers' papers might be less numerous—a loss that could be borne with some equanimity—and the selection of men to fit subjects rather than making the subjects conform to the limitations of willing authors of convention papers might be a task of some difficulty, but one well worth undertaking. In many cases the plan of making a paper or number of papers merely brief presentations of a subject for discussion could be carried out with benefit; for it is the common experience of the editor in abstracting formal technical papers to find that entire pages can be neglected as little more than padding, introduced apparently in conformity with what is believed to be a technical literary style of presentation. In short, the desideratum appears to be to have the program represent fully and solely the central-station questions of the day; to limit papers to a minimum number and, as far as possible, to an outline for the guidance of discussion; and, above all, in the allotment of time, to recognize the fact that, except in rare cases, a discussion is apt to be of much higher value than the paper upon which it is based. However, any systematic study of the problem should result in a program policy that will put an end to the amateurish and unbusinesslike programs which have characterized conventions of recent years, and which fall very considerably short of being creditable to the great industry and to the highly intelligent and substantial type of men represented by the National Electric Light Association.

Johns Hopkins Course in Illuminating Engineering.

The Illuminating Engineering Society has arranged for a course of thirty-six lectures on illuminating engineering, with accompanying laboratory work, at Johns Hopkins University, Baltimore, extending from October 26 to November 8, 1910. The lectures, which will be given under the joint auspices and control of the society and the university, will follow immediately the annual convention of the society which, upon the invitation of the president of the Johns Hopkins University, will be held at that institution, beginning Monday, Oct. 24, 1910.

The origin of the course was due to a recognition by the society that there is an increasing demand for trained illuminating engineers and that the present facilities available for the specialized instruction required are inadequate. The specific objects of the course are to indicate the proper coordination of those arts and sciences which constitute illuminating engineering; to give practicing engineers an opportunity to obtain a conception of the science of illuminating engineering as a whole, and to furnish a condensed outline of study suitable for elaboration into an undergraduate course for introduction into the curricula of undergraduate technical schools. The subjects and scope of the lectures have been proposed by the society and approved by the university. The lecturers have been invited by the university upon the advice of the society.

The university will provide facilities for demonstrations at lectures and will also have installed a working exhibit of apparatus for experimental work in light, illumination and illuminating engineering. This apparatus will be at the disposal of those who attend and an opportunity will be afforded to undertake laboratory work during the term of the lecture course under the supervision of trained experts of the university and of the society. A fee of $25 will be charged for admission to the course and to the accompanying laboratory instruction. Following is a list of the lectures:

"The Physical Basis of the Production of Light (three lectures); Joseph S. Ames, Ph.D., professor of physics, the Johns Hopkins University. "The Physical Characteristics of Luminous Sources" (two lectures): Edward P. Hyde, Ph. D., president, Illuminating Engineering Society; director of physical laboratory, National Electric Lamp Association. "The Chemistry of Luminous Sources" (one lecture); Willis R. Whitney, Ph. D., director of research laboratory, General Electric Company; past president, American Chemical Society. "Electric Illuminants" (two lectures); Charles P. Steinmetz, Ph. D., consulting engineer, General Electric Company; past president, American Institute of Electrical Engineers; professor of electrical engineering, Union University. "Gas and Illuminants" (two lectures); (1) M. C. Whitaker, B. S., M. S., professor of industrial chemistry, Columbia University; (2) Alexander C. Humphreys, M. E., Hon. Sc. D., president of Stevens Institute of Technology; past president, American Gas Institute. "The Generation and Distribution of Electricity, With Special Reference to Lighting" (two lectures); John B. Whitehead, Ph. D., professor of applied electricity, the Johns Hopkins University. "The Manufacture and Distribution of Gas, With Special Reference to Lighting" (two lectures); (1) A. G. Glasgow, M. E., M. I. C. E., London, England; (2) Mr. Walter R. Addicks, vice-president of Consolidated Gas Company, New York. "Photometric Units and Standards" (one lecture); Edward B. Rosa, Ph. D., physicist, National Bureau of Standards. "The Measurement of Light" (two lectures); Clayton H. Sharp, Ph. D., test officer, electrical testing laboratory, New York City; past president, Illuminating Engineering Society. "The Architectural Aspects of Illuminating Engineering" (two lectures); Walter Cook, A. M., vice-president, American Institute of Architects; past president, Society of Beaux Arts Architects. "The Decorative Aspects of Illuminating Engineering" (one lecture); Mr. Louis C. Tiffany, president of the Tiffany Studios, New York. "The Physiological Aspects of Illuminating Engineering" (two lectures); P. W. Cobb, B. S., M. D., Physiologist of the Physical Laboratory of the National Electric Lamp Association. "The Psychological Aspects of Illuminating Engineering" (one lecture); John B. Watson, Ph. D., professor of experimental psychology, Johns Hopkins University. "The Principles and Design of Interior Illumination" (six lectures); (1) L. B. Marks, B. S., M. M. E., consulting engineer, New York City; past president, Illuminating Engineering Society; (2) Mr. Norman Macbeth, illuminating engineer, the Welsbach Company. "The Principles and Design of Exterior Illumination" (three lectures); (1) Louis Bell, Ph. D., consulting engineer, Boston, Mass., past president, Illuminating Engineering Society; (2) E. N. Wrightington, A. B., Boston Consolidated Gas Company. "Shades, Reflectors and Diffusing Media" (one lecture); Van Rensselaer Lansingh, B. S., general manager of Holophane Company. "Lighting Fixtures" (one lecture); Mr. Edward F. Caldwell, senior member of firm and designer, Edward F. Caldwell & Company, New York. "The Commercial Aspects of Electric Lighting" (one lecture); John W. Lieb, Jr., M. E., third vice-president of New York Edison Company; past president, American Institute of Electrical Engineers. "The Commercial Aspects of Gas Lighting" (one lecture); Walter Clark, M. E., president of the Franklin Institute, Philadelphia; third vice-president, United Gas Improvement Company, Philadelphia. The laboratory demonstrations will be under the direction of Mr. Charles O. Bond, manager of photometric laboratory, United Gas Improvement Company, Philadelphia; Dr. Herbert E. Ives, Ph. D., physicist, physical laboratory, National Electric Lamp Association, and Mr. Preston S. Millar, Electrical Testing Laboratories, New York; general secretary, Illuminating Engineering Society.

A. I. E. E. Annual Convention.

The annual convention of the American Institute of Electrical Engineers will be held at Jefferson (White Mountains), N. H., June 27-30. Headquarters will be in The Waumbek, where the meetings will also be held. Among the social events arranged for the convention are the following:

Reception and dance, Monday evening, June 27. Golf and tennis tournaments, for which prizes have been arranged by the entertainment committee, Tuesday afternoon. Trip to Mt. Washington on Wednesday, for which a rate of $5 has been secured. On Thursday there will be a ball game, the golf and tennis games will be concluded, and in the evening there will be a putting contest by electric light. Automobiles and carriages for pleasure trips may be hired at the hotel.

The hotel management has made the following rates, on the American plan, for members and guests who attend the convention. Single rooms, $4 per day per person; with bath, $5 to $6; double rooms, for two persons, $7.50 per day; with bath, $9; two single rooms, bath connecting, for two persons, $10 to $11 per day; one double and one single room communicating with bath, for three people, $13 to $15 per day.

On Wednesday evening there will be a dinner and discussion by the sections committee and section delegates. On Thursday evening there will be a dinner under the auspices of the educational committee, after which there will be a discussion on educational subjects. Fifteen papers will be presented at the meeting, as follows:

Headlight Test, by Prof. C. Francis Harding and Assoc. Prof. A. N. Topping, of Purdue University.—*Light Standards,* by Dr. Edward B. Rosa, Bureau of Standards.—*Modern Oil Switch,* by Mr. A. R. Cheyney, Philadelphia Electric Company.—*Disruptive Strength with Transient Voltages,* by Dr. Charles P. Steinmetz and Mr. J. L. R. Hayden, General Electric Company.—*The Electric Strength of Air,* by Prof. John B. Whitehead, Johns Hopkins University.—*Vector Power in Alternating-Current Circuits,* by Dr. Arthur E. Kennelly, Harvard University.—*Determination of Transformer Regulation Under Load Conditions and Some Resulting Investigations,* by Prof. Adolph Shane, Iowa State College.—*American Telegraph Engineering; Notes in History and Practice,* by Mr. Wm. Maver and

Mr. Donald McNicol, New York.—*Telephone Engineering Around the Golden Gate,* by Mr. Arthur B. Smith, Automatic Electric Company, Chicago.—*Interaction of Flywheels and Motors When Driving Roll Trains by Induction Motors,* by Mr. F. G. Gasche.—*Recent Progress in Exact Electrical Measurements,* by Dr. Clayton H. Sharp and Mr. W. W. Crawford, Electrical Testing Laboratories, New York.—*Electric Locomotive Design,* by Messrs. N. W. Storer and R. W. Eaton, Westinghouse Electric & Manufacturing Company.—*A Method of Determining the Adequacy of an Electric Railway System,* by Mr. R. W. Harris. —*Third-Rail Construction,* by Mr. Jesse H. Davis, B. & O. Railroad, Baltimore.—*Power Economy in Electric Railway Operation—Coasting Clock Tests on the Manhattan Elevated Railway,* by Mr. H. S. Putnam, New York.

Expansion of Guanajuato Power and Electric Co.

The electric light and power plant of the Potosi Electric Company, of San Luis Potosi, Mexico, has been acquired by the Central Mexico Power Company, which is a subsidiary concern of the Guanajuato Power & Electric Company. The distance from the present distributing station at Guanajuato to San Luis Potosi is 87 miles, and it is more than double that distance to the Guanajuato company's hydroelectric plant in the State of Michoacan. The Potosi plant has a capacity of 1000 hp, but is planned by the Central Mexico Power Company to supply the city with 5000 hp, and more if needed. The Guanajuato Power & Electric Company is rapidly expanding its business. It is already furnishing power from two hydroelectric plants, one on the Duero River and the other on the Angulo River, both in the State of Michoacan, and having a total capacity of 10,000 hp. The company is erecting a third hydroelectric plant which will have a capacity of 10,000 hp, which latter will be finished by the first of the coming year, it is stated. It was the introduction of cheap electric power into the ancient Guanajuato mining district by this company a few years ago that has caused a complete rejuvenation of that rich region and enabled the opening of many mines that before could not be worked profitably, causing the Guanajuato district to be developed into the richest mining section of Mexico and being the direct means of many Americans making large fortunes in the industry there. The company is also supplying electric power to the cities and industries of Leon, Irapuato, Celaya, Salamanca, La Barca, Ocotlan and Aguas Calientes, and will extend its system to Zacatecas. It has a working arrangement with the Chapala Hydroelectric & Irrigation Company which is developing a big amount of power in the vicinity of Guadalajara.

Patent Laws.

At the annual meeting last week in New York of the National Association of Manufacturers, a committee consisting of Messrs. Stephen C. Mason, Arthur C. Fraser and O. B. Bannister made a report on various subjects relating to patents and patent law. It approved of several bills now before Congress designed to correct the injustice of the United States appropriating patents without proper compensation to the patentee. While the United States Supreme Court has said that a patented invention cannot be appropriated or used by the Government without just compensation, on the other hand, it was held that Congress has never provided for suits founded upon wrongful acts, and that, therefore, the United States is not liable to suit for infringement of patents, no matter how wanton such infringement may be.

The report strongly endorses the bills now before Congress to establish a court of patent appeals. This provides for the creation of a new court to sit at Washington and hear appeals from the nine U. S. Circuit Courts throughout the country. It is stated that patent litigation as at present conducted, with nine courts of appeal with equal authority and with separate jurisdiction, involving the necessity for many independent suits on the same matter, with excessive expensive technical testimony and voluminous records, frequently followed by diametrically opposed final decisions in the various jurisdictions, is an intolerable burden to the owners of patents and to manufacturers, regardless of the side of the litigation with which they may be connected. The measure now before Congress is pronounced to be a most practical remedy for the present conditions, which will operate to diminish the expense of litigation and shorten the period thereof, and furnish a uniformity of construction of the law so that owners of patents and manufacturers may have some assured certainty of what their legal status is, without the excessive expense and long delay that at present obtains. The members of the association are asked to take up individually the matter with their representatives of Congress, and use their influence to secure an enactment of this measure.

The committee disapproves a bill before Congress which provides that patent suits may be brought before the U. S. Supreme Court on appeal. Such a measure, it is stated, would not only not improve the present situation, but operate further to complicate matters and lead to an interminable delay in the adjudication of cases. Reference is made to a bill now before Congress which provides that every patentee shall immediately after the passage of the act file with the Commissioner of Patents a notice, with a statement of the royalty for which he will grant licenses under the patent, that all patented articles must be marked with this royalty, and that there shall be no variation in royalty as for different objects of manufacture. This measure is stated to be most radical, illogical and vicious, and if passed would practically annul and destroy the value of American patents and the American patent system. The committee also opposed what is stated to be a movement to secure legislation to commit the Government to the theory that, having granted a patent, the Government ought to uphold it by some sort of an official guarantee to take up the prosecution of infringement. Such legislation is stated to be utterly impracticable, as it would be a stupendous task for the Government to undertake the enforcement of patents against those who might technically infringe them.

The committee asked approval of a bill now before Congress relating to procedure in the Patent Office, whereby the commissioner of patents, the two assistant commissioners and the three examiners-in-chief shall constitute a board of appeal, which shall hear all appeals from the examiners, thereby cutting out one appeal. Another bill, providing for cutting down the time within which an application for a patent must be argued and amended from two years to six months, is not approved. The committee, however, believes that there should be a reasonable limit on the delays which may be incurred in the Patent Office, and that any delay beyond such limit should go to shorten the time of patent protection. It is suggested that the association shall recommend to Congress the passage of an act providing that no patent granted shall remain in force after the expiration of 20 years from date of application therefor, except where the granting of the patent is delayed by interference proceedings; in which case the commissioner shall determine the extent of such delay which is not due to the acts of the applicant, and add the period thus determined to the said 20 years, provided that in no case a patent shall remain in force longer than 17 years.

Overhead Construction for Electric Railways.

A paper entitled "Electric Railway Catenary Trolley Construction," by Mr. W. N. Smith, and another on the "Application of Porcelain to Strain Insulators," by Mr. W. H. Kempton, were presented at a meeting of the American Institute of Electrical Engineers held in New York May 27, under the auspices of the railway committee.

Mr. Smith described present-day American practice in overhead construction and discussed at considerable length the various details of the structures. American practice was compared with that of Europe and results of experiments, both here and abroad, were taken up and the lines of new develop-

ment indicated. The paper is very complete and furnishes an excellent record of things done.

Mr. Smith divides the catenary construction into three fundamental types, namely, plain single catenary with trolley suspended directly from the messenger; compound or three-wire single catenary, in which the trolley wire is suspended from a tight secondary just above it, the secondary wire being in turn supported by a messenger; and finally, the double catenary which employs two messengers and one trolley, as is typified by the New Haven construction.

It is recommended that all wooden poles be treated, as the life is thus extended from 30 to 100 per cent. Steel tubular poles are said to be less economical of weight than any other type of steel pole. All things considered, the author believes the tripartite pole to be the best steel pole for railway work. It is accessible and can easily be painted, and being made of Bessemer steel, it is practically rust proof. Concrete poles are said to be gaining in favor and under certain conditions can compete with wooden poles as to first cost. They are stronger than wood and their life is practically indefinite.

It is the author's opinion that trolley wires should always be strung over the center of the track, even when sliding bows are used and that large effects in curves should not be allowed. Hangers of all types are illustrated and discussed and the author doubts the wisdom of introducing adjustment features, intended to increase the flexibility. He claims that the New Haven method of using a steel trolley hung from an auxiliary trolley of copper gives flexibility, due to staggering of the supports; and that tension in the trolley is maintained more uniform by the greater expansion and contraction of the copper messenger.

Experience has shown that it is very important to maintain a sufficient tension in the trolley wire if smooth operation is to be expected. In Europe it is becoming standard practice to equip the lines with automatic tension devices, while the tendency here seems to be to install the wire at such a tension that it will be sufficiently great in the hottest weather and yet not strain the wire beyond the elastic limit in the coldest weather. The sliding bow is thought to be the best collector for present-day conditions and that with an increase in power of the locomotives incident to trunk line operation the development will tend toward a roller pantagraph.

Mr. Kempton's paper dealt with the design of strain insulators. Tests on different types were described and the results discussed. Tests made to determine the inter-relation of simultaneous mechanical and electrical stresses gave no definite conclusions. At a result of his investigations, the author concludes that for high-tension work porcelain strain insulators are superior to moulded ones. He also points out that for both high and low-tension construction the use of wooden strain insulators is coming more and more common, and that service tests prove them reliable.

In discussing Mr. Kempton's paper, Mr. Percy H. Thomas said he believed it to be highly desirable to determine definitely the theory of the inter-relations of simultaneous mechanical and electrical strains. Until such theory is established the speaker advised that tests should include the simultaneous application of mechanical and electrical stresses. Mr. C. J. Hixon, of the General Electric Company, laid great stress on the matters of flexibility of the trolley wire if good results are to be obtained in the operation of collectors at high speed.

Mr. R. D. Coombs, of the Pennsylvania Tunnel & Terminal Railroad Company, told of the tests made by that company on the Long Island test track. It was Mr. Coombs' opinion that the simple single catenary with flat-iron strap hangers looped over the messenger so as to allow of a vertical motion, offered a satisfactory form of over-head construction. He thought that the question of tension did not play such an important part in the operation of a successful system as to justify all the expense and trouble often devoted to it. With reference to tension in the trolley wire Mr. R. C. Thurston, of the Erie Railroad, said that when the tension is slack, a high wind has been known to deflect the trolley wire until the hangers brushed the contact shoe.

The general problem of energy collection was clearly stated by Mr. Charles Rufus Harte, of the Connecticut Company. According to his statement the successful system for energy collection by a moving train involved the consideration of collector design as well as the type of overhead construction. The overhead structure should be uniform throughout its length, and a perfectly rigid conductor, which would approximate a third rail, should be equally as satisfactory as a perfectly flexible structure. The collector itself should be a compound mechanism; one point designed to take care of the large variations in height of the wire and another of small inertia to follow the minute and rapid variations. He suggested a type in which the angular displacement of the top member or flap would actuate air valves and operate the main or pantagraph member, so as to keep the pressure against the wire about constant. A stop could be provided to force down the pantagraph in case other air cylinders did not have time to act. Mr. Harte gave much interesting information regarding the results of the extensive tests being carried on by the Connecticut Company and promised to send in a written communication, which would give specific data.

Chairman William McClellan stated that the only way to get satisfactory results was with a flexible overhead system. He believed that the latest New Haven construction is a step in the right direction and yet it is not a satisfactory solution of the problem. In his opinion the overhead construction would finally come to straight poles on the sides and cables between them to carry the catenary as is done in the Erie yards.

Industrial Education.

At the annual meeting last week in New York of the National Association of Manufacturers, Mr. E. F. Du Brul submitted a supplemental report on industrial education, in which he described the progress of the co-operative course of the University of Cincinnati, which provides a method whereby the student is an apprentice in a manufacturing establishment during the period he attends the university. A similar report was made by Mr. Du Brul two years ago, and the growth of the course is described as being most gratifying both to the university and to the manufacturers of Cincinnati. The first year barely enough students could be interested to start the course. The second year approximately 800 inquiries and applications were received at the university, and 60 students were selected to go into the course. The third year there were over 2000 inquiries and applications, and 80 students were selected. Last summer, the beginning of the fourth year, over 3000 inquiries and applications were received, and 75 students were selected, this being the maximum number that the university could then accommodate. During the present year there will probably be from 4000 to 5000 inquiries, and possibly 125 students will be taken on. The report also describes the "Continuation School" recently established in Cincinnati for boys who go to the workshop with schooling not extending much, if any, beyond the second grade. The school is at present conducted by the Cincinnati School Board, and has nine sessions a week of four hours each. The workshops send their apprentices for one session, or one half day a week, arranging the time to suit the convenience of the shops so that all of the boys are not in school at the same time. The boys are given pay for the time they spend in school. At present 275 boys are enrolled, but next fall there will be 500 boys from machine shops alone.

Fire at Wilmington City Electric Company's Plant.

Lightning entered the power house of the Wilmington City (Del.) Electric Company last week and destroyed the switchboard. The fire did not enter the machine-room, but all ma-

chinery was damaged by water and the loss is roughly estimated at $50,000. The plant was fully insured. The cutting off of the source of energy from the distribution networks threw the city into a state of confusion, by lack of energy for light and motors. All the lines of the Wilmington City Railway Company were tied up and the streets were dark.

The Wilmington Light, Power & Telephone Company, which is a new company, came graciously to the assistance of the City Electric Company by supplying men and wherever possible by connecting service to its own lines. The industrial load is mostly 220 volts, direct current, while two-phase, 60-cycle energy is also furnished. Therefore the new company, which supplies only three-phase, 60-cycle energy, except some direct current from a small substation, was unable to take any of this load.

New York Public Service Commission News.

Mr. Samuel Rea, second vice-president of the Pennsylvania Railroad Company, called upon the chairman of the Public Service Commission last week to urge the early construction of a subway on the west side of New York City to distribute the passengers who will come in through the new terminal station at Seventh Avenue and Thirty-third Street. Mr. Rea said that his company did not care who built or operated the subway, but that it was the opinion of the officials that more practical connections could be made if the line was made a part of the present subway, which is now operated above Forty-second Street. The chairman of the commission told the railroad official that the engineers of the commission were already studying the possibility of building a line down the west side to the Battery and north to Fifty-ninth Street, thence east to the Queensboro Bridge. He said that the work would be pushed as rapidly as possible, and would be the next subway proposition taken up by the commission.

The hearings before the Public Service Commission upon the reorganization plan proposed by the Third Avenue Railroad bondholders committee are being continued daily. At one of the hearings last week, counsel for the newly incorporated Third Avenue Railway Company appeared and asked that this corporation be made a party to the proceedings, and stated that the attorneys who now represent the bondholders would represent the new company at the subsequent hearings. Much of the time at these hearings has been taken up with investigation into the methods of financing adopted by the old company prior to the receivership.

Hearings were held by the commission last week upon the applications for franchises from the Third Avenue Bridge Company to cross Queensboro Bridge, and from the South Shore Traction Company, now operating cars on the bridge, for a line through Sixtieth Street.

The Board of Estimate and Apportionment has received the report of the comptroller as to the amount of self-supporting subway bonds that the board may petition the Appellate Division of the Supreme Court to exempt from the debt limit. This amount was figured as being $14,225,000, which is in addition to the $13,000,000 made available in the corporate stock budget. As the amounts are not sufficient to construct the Broadway-Lexington Avenue tri-borough subway there is a sentiment among city officials in favor of constructing this line by private capital.

The Board of Estimate last week denied the application of the Eleventh Avenue and Fifty-seventh Street Railroad Company for a franchise to operate across the Queensboro Bridge and in Manhattan. This action was taken upon the adverse report of the chief engineer of the board.

The Public Service Commission, Second District, has authorized the East Hampton Electric Light Company, of East Hampton, Suffolk County, to execute and deliver to the New York Trust Company a first mortgage upon its property, to secure an issuance of 6 per cent, 25-year gold bonds in the aggregate amount of $60,000; the company is also authorized to issue at the present time $34,500 in bonds, the proceeds to be used in discharging obligations incurred in the improvement and betterment of the company's plant.

The Economic Power & Construction Company has been authorized to transfer and sell to the Geneva-Seneca Electric Company all its franchises, systems, works and property of the Economic Company in the city of Geneva. The consent is given on the express condition that the Geneva-Seneca Electric Company shall at any time within 30 days, if thereunto requested by the city of Geneva, enter into a contract with the city for the rental of two ducts or conduits for the carrying of electric wires in each of the Exchange Street, Seneca Street and Linden Street subways, for a term expiring March 31, 1928, at an annual rental of 5 cents per lineal duct-foot. In this connection the application of the Economic Power & Construction Company for authority to exercise franchise granted by the city of Geneva is denied.

The Geneva-Seneca Electric Company is authorized by the commission to issue bonds secured by an existing mortgage to an amount not exceeding $114,444, to be sold at not less than 90, and to use $103,000 of the proceeds for the sole purpose of paying for the property of the Economic Power & Construction Company in Geneva.

The Orange County Traction Company has been authorized to issue a first and refunding mortgage upon all its property, estates and franchises of the company to the Union Trust Company, of Albany, as trustee, to secure the payment of $750,000 in 50-year, 5 per cent bonds; the company is also authorized to issue at once bonds to the amount of $233,800 to be sold at not less than 85. The proceeds are to be used to discharge indebtedness of the corporation incurred in additions, improvements and equipment. The company is further authorized to issue bonds to the amount of $425,000 at not less than par without further authorization of the commission for the purpose of refunding existing bonded indebtedness, bonds to be exchanged at any time, par for par.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue of new capital stock of the par value of $30,000 by the Shelburne Falls Electric Light & Power Company, for the purpose of enabling the company to purchase all the property rights, privileges and franchises in the towns of Shelburne and Buckland owned by the partnership of E. J. Halligan and C. H. Wilcox, doing business under the firm name of the Shelburne Falls Electric Light & Power Company. At the hearing which was recently given on this petition it was stated that the Greenfield Electric Light Company has taken steps to purchase the Shelburne Falls property, and about $46,000 will be expended in improvements. The Greenfield company has a dam and power house at Gardner's Falls, on the Deerfield River below Shelburne Falls, and is planning to install machinery there to enable operation to be effected in multiple with the Greenfield company's plant in Greenfield. The estimated cost of the transmission line from the Gardner Falls station to the Buckland and Shelburne bridge was stated to be $4,850, the line consisting of two arc circuits of No. 4 B. & S. copper, one three-phase circuit of No. 2 B. & S. copper, and two single-phase circuits of No. 2 B. & S. copper, the distance being 7122 ft. New station equipment, mainly for switching and measurements, is to be installed at Gardner's Falls at a cost of about $5,994, and the estimated cost of new line construction, transformers and meters in and around Shelburne Falls and Buckland is $2,600. As soon as the Buckland connections are made a new business campaign is to be inaugurated. The value of the entire plant was figured at $32,570, according to actual construction costs.

The commission has approved the consolidation of the Lynn Gas & Electric Company and the Marblehead Gas & Electric Company.

CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

General Report of the Proceedings of the Thirty-third Convention Held in St. Louis, Mo., May 23-27.

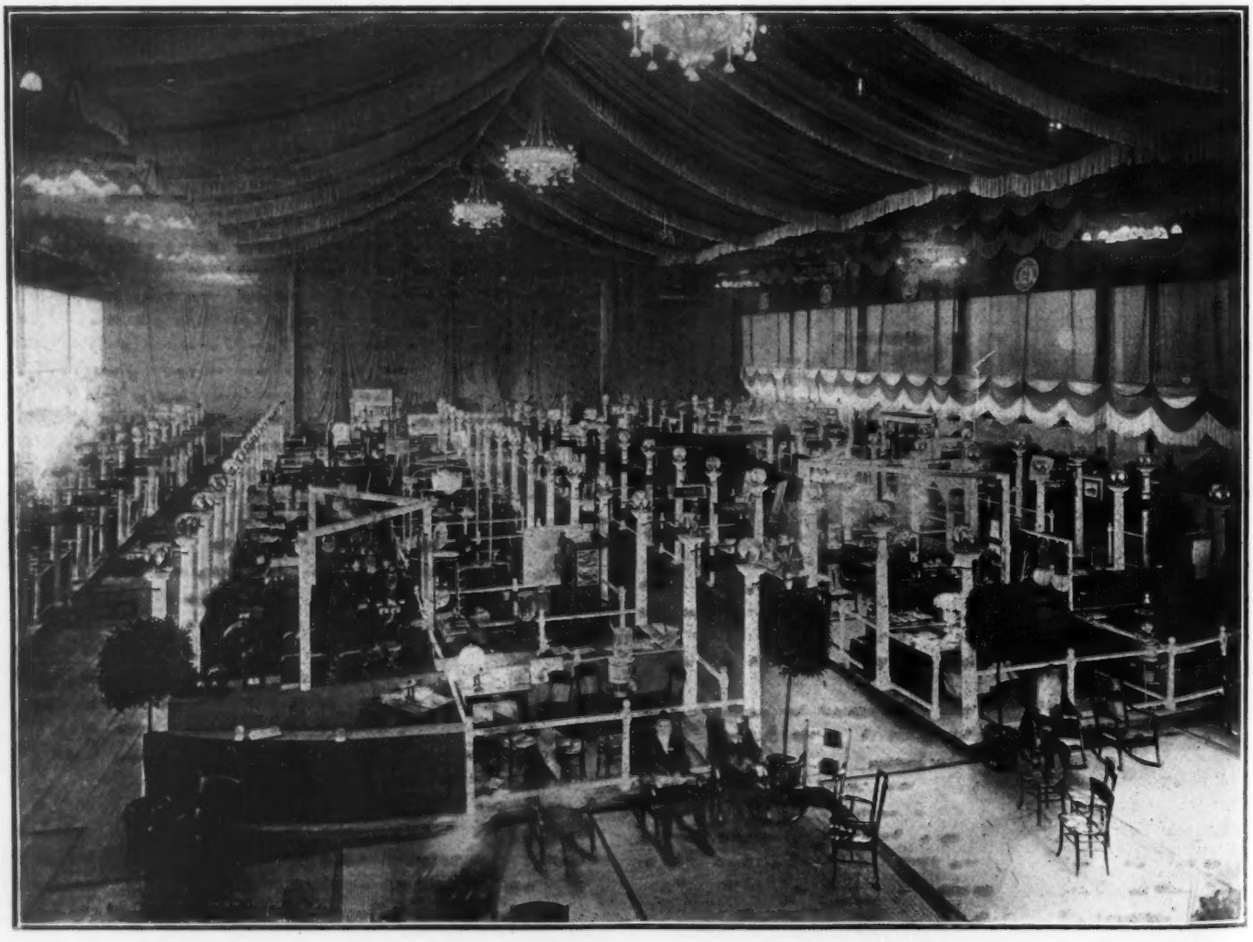
THE St. Louis Convention of the National Electric Light Association was marked by a total registration of 2644 persons, 607 more than registered at the Atlantic City meeting last year. During the year the membership has grown from 3215 under President Eglin to 5533 under President Frueauff. Including members of company sections but not of geographical sections the grand total is 8239.

Not less than 72 entries were listed on the program, and on Thursday afternoon there were simultaneous meetings of the Company Section, Technical Section, Commercial Section and of Class D members. At other times three simultaneous sessions were the rule. The meetings were held in the Coliseum. The main room comprised the stage and surrounding gallery in the rear of the Exhibition Hall, and although this was curtained off from the main hall, it was not free from the noises there. Coupled with this the acoustic properties of the room were very faulty indeed, but this defect was remedied in a measure by the erection of a booth for the speaker and the stringing of fine wires across the room, the wires radiating from a point above the head of the speaker. Directly below the stage was Meeting Room No. 2 where the accounting and company sessions were held, and beneath the galleries on the west side was Meeting Room No. 3 where some of the technical sessions were held. In none of the meeting rooms were the acoustics all that could be desired.

The registration of members and the distribution of badges and papers followed a carefully arranged plan. The registration booths were located on the right as one entered the building. Here an envelope containing a badge, program and book of street railway tickets was given each person registering, while members entitled to papers were supplied with these in two envelopes at a booth opposite the registration booths. The exhibits of the meter and accounting committees were respectively located to the left and right of the entrance doors to the main hall. The booths of the entertainment and exhibition committees were at the head of the line of displays facing the main entrance on the center aisle, while the booth of the executive secretary was at the far end of the hall opposite the left entrance to the large meeting room.

Entertainment features were ample for taking care of the ladies in attendance, and the delegates were provided with a vaudeville show at Delmar Garden on Thursday night. Those who preferred an operatic performance had their tickets honored at the Operatic Theatre box office. The Coliseum is disadvantageously located with respect to the leading hotels, but through the courtesy of Capt. Robert McCulloch of the United Railways Company of St. Louis free transportation was afforded to all registered persons during the convention week, a book of twenty passes being provided with each badge. In this way there was no expense attached to delegates in traveling to and from hotels.

Three new sections came into existence during the convention, a commercial section, a transmission section, and a company section, and much interest was manifested in the for-



General View of the Coliseum During N. E. L. A. Convention.

mation of each. All the various sessions were well attended and the anniversary meeting on Wednesday night brought out the most enthusiastic crowd of the entire convention. Mr. W. W. Freeman was elected president of the national body at the closing session on Friday morning and Mr. H. L. Doherty was elected president of the transmission section at its meeting on Thursday. Telegraphic accounts of the first session were published last week.

LAMPS.

The first paper to be presented at the afternoon session on Tuesday was a report of the Lamp Committee by Mr. W. F. Wells, of Brooklyn, read by Mr. E. E. Witherby of the committee. The committee calls attention to recent publications in the association *Bulletin* relating to the frosting, etching and coloring of incandescent lamp bulbs, the handling of incandescent lamps and the effect of regulation. Mention is also made of developments in tungsten lamps. There was no discussion.

Following the Lamp Committee's report came a paper by Mr. A. G. Strickrott, of Schenectady, entitled "Periodic Lamp Renewals and Customers' Service Inspection," which, in the absence of the author, was read by Mr. C. S. Van Dyke. The author outlined the advantages attending the inspection of customers' lighting installations while making periodic lamp renewals. Messrs. W. H. Bogart, of New York; W. H. Gardiner, of New York; P. S. Millar, of New York; M. C. Osborn, of Spokane; H. B. Gear, of Chicago, and H. Almert, of Chicago, took part in the discussion following the reading of the paper. Mr. Gardiner said that closest attention should be paid to inspections rather than to renewals, and Mr. Millar called attention to the considerable variations he found in the voltage of the lamp socket and said that the plan outlined in the paper should be of great value in advising managers concerning conditions in customers' installations and in fostering a feeling of good will toward the company. Mr. Gear related the experience of the Commonwealth Edison Company in calling from house to house, which led to the abandonment of the scheme. His company has educated its customers to notify it when renewals are desired and Mr. Almert testified to the excellence of the system in vogue in Chicago.

An illustrated lecture on "Magnetite and Flaming Arcs versus Open and Enclosed Carbon Arcs for Street Illumination" was given by Mr. W. D'A. Ryan, of Schenectady, showing the comparative merits of various forms of direct-current series arc lamps in street lighting service.

Following Mr. Ryan's lecture Mr. C. F. Scott, of Pittsburg, read a paper on a "New Form of Tungsten Lamp." The lamp described is made of a continuous wire forming the filament, which is mounted so as to avoid all points of rigid support. The arrangement is such as to minimize fragility, and that this quality is possessed by the lamp was demonstrated at the close of the paper by apparatus made for the purpose. The discussion following the reading of the paper was brief, and was participated in by Messrs. H. E. Grant, of Vancouver, B. C.; Farley Osgood, of Newark; E. L. Callahan, of Chicago; F. W. Prince, of Hartford, and R. D. Ferguson, of Chicago, all of whom requested the author to reply to certain questions regarding the lamp.

The final paper of Tuesday's session was entitled "High-Efficiency Lamps," by Mr. S. E. Doane, of Cleveland. The paper however, was more of a discussion of the method of charging for electrical energy as effected by high-efficiency lamps and advocated a scheme laying greater stress on a customer charge. A long discussion followed. Mr. Alex. Dow, of Detroit, said that the tungsten lamp cannot be ignored by the central station company, and that rates must be made to meet the conditions. On the other hand, the lamp manufacturers would have to turn out a less fragile lamp and at lesser cost. He did not agree with all of Mr. Doane's conclusions. New customers do not always necessitate increased cost of mains, and the minimum bill plan is unpopular. There is danger, also, in the opinion of Mr. Dow, of complaint concerning discrimination against the small consumer. Mr. H. L. Doherty, of New York, claimed that a central station company furnishes both a commodity and a service, and rates should take this into consideration. He enlarged upon this view and showed that the amount of apparatus connected to the lines is many times greater than that installed in the central station, and each customer added requires only about 0.2 kw of increased station apparatus. Mr. H. W. Peck, of Rochester, cited the conditions which exist in his city, and showed wherein the proportionate charges given in Mr. Doane's paper vary from those in Rochester. Mr. H. J. Gille, of Minneapolis, also joined in the discussion.

OVERHEAD LINE CONSTRUCTION.

The first technical session began on Wednesday morning under the guidance of Mr. W. W. Freeman as chairman. The report of the overhead line construction committee was presented by its chairman, Mr. Farley Osgood, of Newark, N. J. It covers 75 pages of text and illustrations and considers the various methods of secondary distribution besides work covering railroad crossings. Embodied as part of the paper is the joint report of the Committee on Overhead Line Construction of the National Electric Light Association and the Committee on Electricity of the American Railway Engineering and Maintenance of Way Association. Last year the committee devoted its report to primary systems, and the expectation of the committee next year is to cover the subject of high-tension systems. It is the intention to issue a book containing the material collected by the committee on these three divisions of line work. In opening the discussion Mr. H. B. Gear, of Chicago, touched upon some phases of overhead construction work not elaborated upon by the committee relating to alley work, and gave the practice of the Commonwealth Edison Company in this matter. He also stated, with regard to the number of transformers which may be banked together, that the practice of his company is not to bank transformers in parallel except where these are above 50 kw in rating. After a general investigation the Commonwealth Edison Company established a policy of installing a separate transformer in the middle of each block and supplying a load on both sides of the alley, resulting in a secondary line of about 400 ft. in length. To interconnect the transformers in adjacent blocks would increase the amount of secondary circuits 75 per cent, and this additional cost outweighed any additional security of service or interchangeability of load resulting thereby. Mr. Warren Partridge, of Springfield, Ill., called attention to the fact that outside of high-tension work engineers paid little attention to distribution circuits, this work being left to the linemen. There was danger also of getting too many transformers banked together and of extending the secondary mains too far. He did not endorse the recommendation of the committee of connecting the lightning arrester ground wire to the neutral ground wire at the transformer, because if this connection proves faulty high-tension currents are introduced directly upon the secondary system. He suggested a separate ground connection for the lightning arrester. Mr. S. B. Way, of St. Louis, and Mr. S. J. Lisberger, of San Francisco, gave details of line construction work in their respective cities. Mr. W. C. L. Eglin, of Philadelphia, expressed a preference for circuit-breakers instead of fuses for line protection where the load is large, and moved that a preliminary book on line construction be issued and submitted to member companies for criticism and additions so that when the final book appears it will contain the best obtainable information on this subject. In summing up, Mr. Osgood made a plea for uniformity of construction of electric light lines throughout the country. A written discussion by Mr. G. E. Wendle, of Williamsport, Pa., was presented later in the session. This contained a criticism of last year's work, together with mention of the benefits he received from the report in connection with a lawsuit with which his company was threatened; the detailed specifications and explanations carrying the indorsement of the N. E. L. A. being of inestimable value in presenting the case.

UNDERGROUND WORK.

The second paper of the day was one on the "Location of Faults in Underground Cables," by Mr. W. A. Durgin, of Chi-

cago, commenting on the characteristics of the various tests in vogue for locating the many troubles that underground distribution systems are heir to. The paper brought forth no discussion other than the remark from Mr. Farley Osgood that the exploring coil method described by Mr. Durgin is used by the Public Service Corporation of New Jersey with satisfactory results.

The next paper, entitled "Departure from Standard Practice in Distribution Methods," by S. B. Way, of St. Louis, was local in color and described the practice of the Union Electric Light & Power Company with respect to underground work where monolithic conduit made in the trench is employed; insulator clamps, insulated mountings for fuses, switches, etc., on poles and motor-operated wire-pulling apparatus. It was pointed out by Mr. Farley Osgood that precautions should be taken to obtain a smooth duct surface, and Mr. B. E. Roffee, of Chicago, called attention to the good fire resisting and heat insulating qualities of concrete, the latter being disadvantageous in transmitting heat generated in the circuits in the ducts.

TERMINOLOGY.

The report of the Committee on Terminology, although scheduled for Friday's session, was read next by its chairman, Mr. W. H. Gardiner, Jr., of New York. This report, which is only tentative, was discussed by Mr. A. S. Loizeaux, of Baltimore, who said that no changes should be made in established rules unless for the better. Dr. C. P. Steinmetz, of Schenectady, explained the predicament of the committee in deciding what definitions or terms could be standardized and which could not in the present state of the art. The terms mentioned in the report were brought up for discussion because the committee composed of a limited number of members could not be familiar with all the practice regarding the use of the words and phrases mentioned. The committee sought the views of the members on the subject so that its work could be thorough and exact.

GROUNDING SECONDARIES.

Mr. W. H. Blood, Jr., of Boston, then presented his report on "Grounding Secondaries." This partook of the nature of a progress report. The committee sent out circular letters to member companies and gives the statistics thus gathered. In two previous reports the committee has recommended a rule prohibiting the grounding of secondary alternating-current systems having potentials exceeding 150 volts between the ground and the line; and, while stating that the committee is still unanimous in its opinion on the matter, this recommendation was withdrawn and such grounding left to the judgment of each company. In grounding circuits the committee claims the best method is to connect the circuit to underground water-pipe systems. In opening the discussion on the paper Mr. Farley Osgood read from manuscript information gathered by him and based on experience covering the general problem why to ground and when to ground. Fire and life hazard, he said, are both reduced by grounding secondary circuits and the ground connection should be made on the premises of each customer, and preferably to a water pipe. Mr. C. W. Stone, of Schenectady, suggested the use of multiple pipe ground connections covered with salt. Like Mr. Osgood, he feels that the life risk is not materially increased by reason of an increase in the limit of potential from 150 volts to 300 volts. Life hazard is not the only controlling feature of grounding, and he felt that as at present practised grounding adds to the fire hazard. Mr. C. E. Allen, of Pittsburgh, also joined in the discussion.

METERS.

The first paper of the second technical session, held Wednesday afternoon, was a report of the meter committee, which was read by Mr. G. A. Sawin, of Newark, N. J. The 164 pages which make up this report deal with the installation, reading and and testing of watt-hour meters and a meter code prepared by the Electrical Testing Laboratories for the joint committee of the Association of Edison Illuminating Companies and the National Electric Light Association. Messrs. W. W. Freeman, of Brooklyn; F. G. Vaughan, of Schenectady; J. B. Seaman, of Philadelphia, and C. G. Durfee, of Rochester, commended the work of the meter committee, and the last named expressed the opinion that the code given in the committee's report should be adopted by the central stations of the country. Mr. Seaman's company has obtained satisfactory results from testing meters by comparison with a rotating standard with a portable load box, one man attending to all the details of testing. Mr. Paul Lüpke, of Trenton, said that a highly accurate meter was not necessary on circuits of small consumers. What is required for such installations is a cheap meter that will without extreme refinement remain accurate. Mr. Durfee extolled the exhibit made by the meter committee as being of inestimable value. Mr. F. V. Magalhaes, of New York, pointed to the necessity of a code which outlines all the functions of meter work and emphasized the fact that any code which is drawn should be gotten up by men competent to state what the reasonable and rigid requirements are of the various functions connected with meter work. In closing Mr. Sawin made a plea for a cheaper meter.

FUSE TESTING.

A paper entitled "Use of the Oscillograph in Fuse Testing," by Mr. Alexander Maxwell, of New York, which was held over from the morning session, was then read by its author. The paper outlines numerous tests made upon Murray type fuses, short-circuited across a storage battery, the observations being made by means of an oscillograph. The paper elicited no discussion.

STEAM TURBINE.

The paper prepared by Mr. Paul M. Lincoln, of Pittsburgh, on the space economy of the steam turbine was next presented. The author pointed out the advantage of the steam turbine over the reciprocating engine because of the saving of space made possible thereby. No discussion followed the reading of the paper.

THREE-WIRE NEUTRAL.

"Methods of Deriving the Neutral for Direct-Current, Three-Wire Systems" was the title of the next paper, whose author was Mr. J. R. Werth, Jr., of Schenectady. In it the writer compares three-wire generators, motor generators and series-operated generators. Messrs. C. W. Stone and R. D. Donaldson, of Washington, D. C., discussed the paper.

GAS ENGINES.

The report of the committee on gas engines was read by Mr. I. E. Moultrop, of Boston, and was followed by the reading of a paper prepared by Mr. Nisbet Latta, of Milwaukee, by Mr. W. Robbins, on "The Adaptation of Gas Power for Central-Station Service." The first paper gives a summary of experiences of companies with gas engines, while the latter paper compares the costs of a gas plant with those of a steam plant for the same service. Both papers were discussed at once. Messrs. E. D. Dreyfus, of Pittsburgh; H. W. Peck, of Rochester; C. W. Stone, of Schenectady, and E. J. Condon, of Harvard, Ill., took issue with the statements made in Mr. Latta's paper regarding the economies of the gas engine over the steam engine, and the last-named speaker gave the experience of his company with a gas-producer plant which was entirely at variance from what it was led to expect when the plant was installed.

TRANSFORMERS.

The last paper read at the Wednesday afternoon technical session was written by Mr. E. G. Reed, of Pittsburgh, and was entitled "Interesting Points About Modern Transformers." In it the author discussed recent developments in transformer design considered from the manufacturing rather than the operating side. The paper was not discussed.

ANNIVERSARY MEETING

At the opening of the anniversary meeting in the main meeting room on Wednesday night Executive Secretary T. C.

Martin read a number of congratulatory telegrams and letters from friends of the association who mingled their congratulations with regrets at not being able to attend the convention. The first of these was from Mr. J. Frank Morrison, the first president of the association; another was from Mr. Edwin R. Weeks, its first vice-president and president in 1889. Mr. T. A. Edison's congratulations were received with cheers. Messrs. Edward Weston and Elihu Thomson each sent messages, and one from Mr. C. A. Coffin was received too late to be read at the meeting. The National Conference of Charities and Correction, which had just ended its sessions in St. Louis, also sent greetings.

THE FOUNDING OF THE ASSOCIATION.

The first paper of the evening, that of Mr. Elmer A. Sperry, of New York, entitled "The Founding of the Association in 1885," was received with not a little amusement. He traced the early history of the organization from its inception and mingled the prophetic sayings of Mayor Harrison, of Chicago, and Dr. Elisha Gray, with the droll discussions of the time, which in the light of present knowledge appear ludicrous. The paper is written in a happy vein with mellowed reminiscences of a mirth-provoking character. The first convention reflected the great controversy going on at the time between telephone and arc lighting interests regarding the stringing of wires.

TWENTY-FIVE YEARS OF CENTRAL STATION COMMERCIAL DEVELOPMENT.

Chief interest centered around the address of Mr. Samuel Insull, of Chicago, on "Twenty-five Years of Central-Station Commercial Development." Mr. Insull, who is a past-president of the association, was greeted with prolonged applause and his address was listened to with marked attention. After sketching the historical, technical and financial aspects of central-station work during the past 25 years, he took up those matters of vital interest to central-station men which leave their mark in increased business, cordial public relationships, better load factors, diversified demands, etc. He stated that central-station business to be most effective and serve the best interests of the community must be a monopoly business, subject to more or less governmental supervision. He does not fear public service regulations and believes that in many respects the companies will be benefited thereby. Mr. Insull's address is given at greater length elsewhere in this issue. At the close of his formal speech the speaker related his first experiences with things electrical and how the impression left was such as to instill into his mind a desire to have some part in the development of the great industry then in its infancy. He appealed to the young men of the profession to devote their best energies in the upbuilding of it. At the conclusion of his talk Mr. Insull was again greeted with an applause which President Frueauff said was plainly indicative of the appreciation of the association and an evidence of the esteem in which he was held.

Mr. Insull's address was followed by the reading of the report of the committee on public policy by Mr. W. W. Freeman. The report consists largely of an appendix containing matters of importance affecting the industry and the comments of the committee on the trend of sentiment and the progress made along the lines of such broad and general matters which have to do with the relations between the industry and the public. At the conclusion of the reading of the report and before going into executive session, a motion made by Mr. Louis A. Ferguson, of Chicago, directing that greetings be extended to Mr. J. Frank Morrison and sympathy to Mr. Charles R. Huntley, past-presidents, was passed.

NOMINATING COMMITTEE.

The convention then went into executive session and elected a nominating committee as follows: Messrs. J. E. Montague, Niagara Falls; C. H. Hodskinson, Boston; W. A. Martin, Toronto; Frank J. Baker, Chicago, and Douglass Burnett, Baltimore. Then followed the report of the secretary and treasurer, Mr. Frank M. Tait. Attention was called to the enormous amount of work handled in the New York office and the secretary gave figures showing the condition of the association.

POWER TRANSMISSION.

In presenting Mr. H. W. Buck's paper on "Present Problems in Power Transmission" before the power transmission section of the association at its first meeting on Thursday, Mr. R. D. Rushmore, of Schenectady, took occasion to say a few words about what led up to the meeting and some of the objects of the organization in the future. He said that power transmission was now 20 years old, and although the American Institute of Electrical Engineers has done very valuable work in this field, it was beyond the capacity of the Institute to supply the field in fullest measure. The questions to be discussed are hardly those which are proper for a purely technical society, and while a few have thought it undesirable to have a power transmission section a part of the N. E. L. A. affiliation with the N. E. L. A. proved to be the most desirable solution. Mr. Rushmore then delivered Mr. Buck's paper in abstract. The paper gave a comprehensive outline of certain problems now being encountered in high-tension energy transmission undertakings, such as towers, spans, insulators, maximum voltage, voltage regulation, arresters and guard wires. In discussing the paper, Mr. J. R. McKee, of New York, cited certain 100,000-volt lines operating without lightning arresters and not hampered with lightning troubles.

THE PUBLIC AND THE WATER POWERS.

Mr. H. L. Doherty, of New York, then delivered an address entitled "The Public and the Water-Powers," discussing the misinformation which has led to burdensome legislation concerning hydroelectric developments. The conservation problem was discussed by Messrs. J. R. McKee, of New York; Dr. C. P. Steinmetz, of Schenectady; W. B. Jackson, Gen. Irving Hale, C. F. Scott and D. H. McDougall.

HIGH POTENTIAL LINE PHENOMENA.

A paper on "High-Potential Line Phenomena" was next read by its author, Dr. C. P. Steinmetz, who gave a simple explanation of some complex phenomena encountered on high-tension transmission systems. This paper was not discussed.

TRANSFORMERS.

Mr. Karl C. Randall, of Pittsburgh, delivered his paper on "Transformers for High-Voltage Transmission" in abstract. The paper deals with temperature rise, cooling, high voltage, insulating, parallel operation and testing of transformers for high-tension transmission work and brought forth no comment.

ORGANIZATION OF POWER TRANSMISSION SECTION.

Following the reading of Mr. Randall's paper the section proceeded to perfect its organization. As the chairman of a committee on nomination of officers and committees for the transmission section of the association, Mr. W. B. Jackson presented the following names of persons, who were subsequently elected to the offices indicated: Mr. H. L. Doherty, president; Messrs. J. R. McKee, H. H. Sinclair and R. M. Wilson, vice-presidents; Mr. D. B. Rushmore, secretary; Mr. Paul M. Lincoln, treasurer. The executive committee consists of the above officers and Messrs. J. B. Montague, Farley Osgood, W. N. Ryerson, B. E. Morrow, John A. Britton, H. M. Byllesby, D. L. Huntington, S. D. Sprong, F. B. H. Paine, J. F. Vaughan and W. H. Blood, Jr.

THIRD TECHNICAL SESSION.

The technical session on Thursday afternoon began with the reading of a report by the committee on protection from lightning and other static disturbances by Mr. B. E. Morrow, of Albany, N. Y., and presented by Mr. H. B. Gear. The committee recommends pipe grounds in preference to plate grounds and calls attention to the desirability of keeping records of lightning arrester performance. Forms suitable for this purpose were incorporated in the paper.

"European and American Switchboard Practice" was the title of the second paper of the session written and delivered by Mr. Stephen Q. Hayes, of Pittsburgh. The author attributes much of the difference between American and European designs to difference in labor costs.

Mr. F. W. Shackelford, of Schenectady, next presented a paper on "Voltage Control of Generators and Feeder Systems" in which he described the switch-type and the induction-type regulators with particular emphasis on the former type. Mr. Paul Lincoln, of Pittsburgh, discussed the paper and did not agree with the author in the methods employed in deriving his conclusions. Dr. Steinmetz also joined in the discussion.

The paper on "Modern Single-Phase Potential Regulators," by Mr. E. E. Lehr, of Pittsburgh, was devoted to a complete description of the induction type regulator. The paper brought forth no discussion.

Mr. John Hunter, of St. Louis, delivered a paper on the "Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis." He gave a detailed description of intakes for the Ashley and Lewis Street stations of the Union Electric Light & Power Company. The paper was not discussed.

The final paper of the Thursday afternoon session was read by its author, Mr. L. T. Robinson, in abstract. The subject of the paper was "Precautions When Using Instrument Transformers," and the writer called attention to the magnitude of error to be expected in using the latest types of instrument transformers. In reply to a question the author said that instrument transformers as now constructed can be used interchangeably with an error not exceeding one-half of 1 per cent.

COMPANY SECTION.

The company section met for the first time on Thursday afternoon and listened to a number of papers and addresses. Mr. W. C. L. Eglin, of Philadelphia, presided and the first paper presented was written by Prof. S. W. Ashe, of New York, and read in his absence by Mr. W. Robbins. In this paper on "Educating the Central-Station Employee," Professor Ashe presents a system of educating central-station men based on courses given by him in New York, Brooklyn, Boston and Baltimore for the Edison Companies. In discussing the subject Mr. H. E. Grant, of Vancouver, described the lectures given before his company section and told how the necessary apparatus, etc., was secured, giving details of the section organization and telling of the enthusiasm of the body in this work.

Following Professor Ashe's paper, Mr. Henry L. Doherty, of New York, made an address in which he spoke of the organization and purposes of the State, company and special sections and the relation each bore to the other and to the national body. He lauded the officers of the national body for their work during the past year and urged upon the company sections to emulate the unselfish spirit of the parent organization in building up the industry. At the conclusion of the address Mr. H. H. Scott outlined the growth and scope of the company sections and Mr. Doherty pointed out that the company section is the first step in the organization into which the new man in the company is brought. Mr. George Hoffman, of Philadelphia, spoke of the company section of the Quaker City, explained its working, and pointed to the necessity of bringing company sections closer together in an exchange of bulletins and papers. He was followed by Mr. Edward G. Schuettge, of Evanston, Ill., representing the North Shore Electric Company section. The latter section not only aims to promote the interchange of ideas relative to the business, but seeks to foster and encourage the get-together spirit of doing things. Mr. Schuettge spoke of the classes of papers presented before his section and the opportunity for success for young men in the field. Mr. R. F. Pack, of Toronto, said that while a company may have the finest generating equipment, best system of accounting and finest distribution system, none of these is any good unless the men running them are right. He looked upon a company section meeting as a place to preach loyalty, ambition, tact and energy. Prof. George D. Shepardson, of the University of Minnesota, spoke on behalf of the educational institution which he represented and welcomed any suggestions from the applied side which will make the work of training men more helpful to it. Mr. B. W. Mendenhall, of Salt Lake City, gave the history of the Utah Light & Railway Company section and thought that the suggestion that manufacturers send out men to lecture among central-station employees was a good one. Mr. L. R. Wallis, as the representative of the Boston Edison section, gave information concerning the section and said that the question box had brought out a lot of hidden talent. He believed that interest in a local section can be stimulated by means of the question box. Mr. E. A. Baily said the Edison Electric Illuminating Company of Brooklyn is a firm believer in the company section idea, and told of the work done by it. This company gives a Company Section Convention yearly with excellent results. Mr. L. A. Coleman, of the United Electric Light & Power Company, New York City, said that within the last few weeks his company formed a company section with a membership of 40 out of a total of 335 employees. Mr. Howard T. Sands, of Malden, Mass., spoke of the organization of the association work of the companies he represented. He was followed by Messrs. C. E. Brenton, of St. Louis; George W. Bixler, of Denver; A. S. Loizeaux, of Baltimore, and H. E. Grant, of Vancouver, all of whom spoke of the work of their respective company sections and the success attending it.

Mr. Eglin answered many questions which were asked during the meeting and called attention to the gold medal offered by Mr. Doherty for the best paper presented at any company section. The prize is offered to inspire the various members in the work and the committee will take under consideration all the papers presented to company sections up to Dec. 31, 1910. Mr. Martin said that he had five good papers which came in too late for publication and presentation at the meeting, which would make good material for some of the company section meetings Mr. Doherty moved for the appointment of a committee consisting of the chairmen of the various existing sections to consider company section work. The new executive officers will make the appointments.

ANNUAL MEETING OF CLASS D MEMBERS.

In the afternoon while the other meetings were in session, Class D members met in the gallery of the exhibition hall. Mr. F. H. Gale presided, and shortly after the meeting was opened, appointed a nominating committee comprising Messrs. J. I. Ayer, A. A. Gray and F. G. Bolles to name candidates to fill vacancies on the exhibition committee. The committee in its report recommended the following, who were elected for the terms indicated: Mr. J. C. McQuiston, of Pittsburgh, to succeed himself for three years; Mr. F. X. Cleary of New York, to succeed himself for three years; Mr. E. T. Pardee of Milwaukee, to succeed Mr. Rodman Gilder for three years. Mr. Charles Blizard of Philadelphia, for one year to succeed Mr. Pardee who was filling the unexpired term of Mr. W. S. Heger; Mr. W. A. Layman of St. Louis for two years to succeed Mr. C. E. Brown who was filling the unexpired term of Mr. H. W. Young. Mr. Gale said that the thanks of the Class D members were due to the citizens of St. Louis who contributed a fund to pay for the use of the Coliseum during the convention, so that it cost the association nothing. He also referred to the untiring and unstinted work of Mr. F. B. Adam of St. Louis in getting the exhibition hall in shape. On motion of Mr. J. I. Ayer of Cambridge, Mass., the secretary was instructed to convey to Miss Harriet Billings, the deep regret of her many friends in the Class D membership at her inability to attend the convention. They particularly wished her to know that her "boys" hoped that her present rest might make it possible for her to attend many future meetings. The secretary-treasurer Mr. Walter Neumuller presented a preliminary report which showed total receipts from exhibitors of $9,155 and a tentative expenditure of about $7,325, leaving a balance of about $1,830. On motion of Mr. J. M. Wakeman of New York, a vote of thanks was extended to Mr. Gale for the excellent work he performed as chairman of the exhibition committee. Mr. Gale responded to the unanimous vote which greeted the motion, gracefully acknowledging the honor and expressing for himself and the committee the pleasure experienced in fulfilling their obligations to the organization.

ACCOUNTING SESSIONS.

The first accounting session was called to order by Mr. John F. Gilchrist, of Chicago, at 10:10 a. m. on Wednesday. He spoke of the value of the broad general experience of the accounting officers of small companies and of the influence of widespread adoption of the association's system of accounts.

Mr. John L. Bailey, of Baltimore, chairman of the uniform accounting committee, presented the report, describing a scheme of accounts for small companies. Mr. E. J. Bowers, of Detroit, read his paper on "Accounting Methods As Applied to Detroit Electric Properties." He explained a method of estimating revenue in order to make statements within a few days after the close of the month. Among those who took part in the discussion were: Messrs. R. F. Pack, of Toronto; H. M. Edwards, of New York; L. A. Coleman, of New York; C. N. Duffy, of Milwaukee; John T. Brady, of Denver; Henry B. Sawyer, of Boston; H. C. Schlegel, of New York; E. J. Allegaert, of Newark; F. L. Dame, of New York; F. J. McCormack, of New York; W. H. Augustus, of Kansas City, and E. A. Barrows, of Providence.

Mr. John M. Mulvihill, of Denver, presented his paper on "Care and Handling of Customers' Accounts," showing the importance of careful treatment of the accounts. Among those who discussed the paper were: Messrs. W. H. Augustus, of Kansas City; J. C. Van Duyne, of New York; E. J. Allegaert, of Newark; Douglass Burnett, of Baltimore; E. C. Scobel, of Rochester; C. E. Brenton ,of St. Louis; W. J. Tharp, of Little Rock; L. A. Coleman, of New York; E. A. Barrows, of Providence; C. G. M. Thomas, of New York; E. T. Penrose, of Altoona, and Wm. T. Nolan, of Rochester.

The paper of Mr. R. F. Pack, of Toronto, on "Storeroom Accounting" was postponed until the Wednesday afternoon session and was then read by the author. Emphasis was laid upon the importance of proper accounting for stores, with particular reference to the needs of small companies. Among those that discussed the paper were: Messrs. W. H. Bogart, of New York; H. M. Brundage, of Peekskill; E. J. Allegaert, of Newark, and H. M. Edwards, of New York. The paper on the "Significance of Statistics," by Messrs. George A. McKana and B. F. McGuire, of Chicago, was read by Mr. McKana. It gave statistics secured by analytical studies of revenues, expenses and business. Among those who participated in the discussion were: Messrs. R. F. Pack; R. S. Hale, of Boston; H. M. Edwards, and John F. Gilchrist, of Chicago.

Mr. H. M. Edwards then presented the report of the subcommittee on "Public Service Commission Relations." He referred to the new laws creating commissions and to the wisdom of introducing the association's classification of accounts, so as to secure a uniformity.

In the absence of Mr. W. W. Dow, of Boston, his paper on "Classification of Income and Sales" was read by Mr. Henry B. Sawyer. Greater attention to the classification of income was urged. Messrs. F. L. Dame, H. B. Sawyer and H. M. Edwards discussed the paper.

Mr. R. D. Rubright's paper on "Job Or Work Order System" explained the methods of the Edison Electric Illuminating Company, of Brooklyn. It was discussed by Messrs. H. M. Edwards, C. E. Brenton, E. T. Penrose and R. F. Pack.

At the Thursday morning session Mr. Douglass Burnett, of Baltimore, read his paper on "Meter Records," describing the methods of the Consolidated Gas, Electric Light & Power Company. Among those who discussed the paper were: Messrs. Hermann Spoehrer, of St. Louis; J. M. Mulvihill, of Denver; H. C. Schlegel; E. Wheeler, of Toronto; C. E. Brenton, E. J. Allegaert, W. T. Nolan, and E. A. Barrows.

The paper of Mr. R. F. Bonsall, of Baltimore, on "Keeping of Customers' Records," was read by Mr. Douglass Burnett. It was discussed by Messrs. E. J. Allegaert, J. M. Mulvihill, F. J. Thomas, R. F. Pack and W. H. Augustus, of Kansas City. Mr. John C. Van Duyne, of New York, read his paper on "The Workings of a Collection Bureau." Among those who discussed the paper were: Messrs. R. F. Pack, L. A. Coleman, E. Wheeler, John F. Gilchrist, H. M. Edwards and C. G. M. Thomas. Mr. A. L. Holme, of New York, then read his paper on "Accounting Symbols," describing the application of symbols to a uniform accounting scheme.

In closing the meeting Mr. J. L. Bailey, chairman of the accounting committee, expressed his gratification at the interest aroused, particularly among the smaller companies. The chief work of the committee in the coming year should be to secure the adoption of the uniform system of accounts.

COMMERCIAL SESSIONS.

Wednesday at 10 a. m. the first commercial session was opened with a paper by Mr. Arthur S. Huey, of Chicago, on "Latitude in Commercialism." This paper criticised very severely the tendency of some managers to busy themselves with technical details which can be taken care of by employees, while important questions of public policy and relations with the public are being neglected. In the discussion Mr. E. W. Lloyd, of Chicago, gave some of the specific improvements in methods made by his company to reduce friction with the public in the ordinary transaction of business. Mr. T. I. Jones, of Brooklyn, told some New York experiences with cut-off notices, commission regulation and exhibitions. Mr. C. N. Stannard, of Denver, told of the advantage of a new-business department in molding public opinion. Mr. M. S. Seelman, of Brooklyn, contrasted the common attitude of public-service corporation managers toward the public 15 years ago and now. Others taking part in the discussion were Messrs. Douglass Burnett, of Baltimore; James T. Hutchings, of Rochester, and H. Almert, of Chicago.

RESIDENCE LIGHTING.

A paper by Mr. H. J. Gille, of Minneapolis, on "Residence Lighting" called attention to the importance of this branch of the business which has been neglected by some companies with the idea that it is not profitable. In the discussion, Mr. M. C. Osborn, of Spokane, gave an analysis of the conditions of demand and income on one of his company's residence feeders. Mr. V. R. Lansingh, of New York, dealt with some residence illumination problems. Mr. George D. Hoffman, of Philadelphia, enlarged on the fact that electricity has come to be considered a necessity in a modern residence. Mr. E. L. Callahan, of Chicago, questioned whether residence lighting alone without heating and miscellaneous load really pays. Mr. Alex. Dow, of Detroit, spoke at length, giving much valuable data in connection with residence service in Detroit, where this business has been so extensively developed. Messrs. B. W. Mendenhall, of Salt Lake City; W. H. Sparks, of Louisville; R. W. Rollins, of Hartford; T. I. Jones, of Brooklyn, and Prof. George D. Shepardson, of Minneapolis, completed the discussion.

CENTRAL STATION ADVERTISING.

Wednesday at 2:30 p. m. the second commercial session was begun with the reading of a paper by Messrs. H. K. Mohr, of Philadelphia, and C. W. Lee, of Newark, N. J., on "Central-Station Advertising." Mr. Lee read the paper. The paper was discussed at great length, most of the discussion being over details of practice and experience. Those taking part were Messrs. L. D. Gibbs, of Boston; M. D. Beardsley, of St. Louis; J. C. McQuiston, of Pittsburgh; P. S. Dodd, of Cleveland, and Douglass Burnett, of Baltimore. Messrs. McQuiston and Dodd brought out the point that there is now available at nominal cost considerable advertising matter and "copy" for newspaper advertisements from the manufacturers if central stations will avail themselves of it.

ELECTRIC VEHICLE OPPORTUNITY.

"The Electric Vehicle Opportunity" was the subject of a paper presented by Mr. Hayden Eames, general manager of the Studebaker Company. Mr. Eames did not confine himself to the printed paper, but made a forcible presentation of the point that the central-station companies are the ones to be most directly benefited by the introduction of electric vehicles.

He pointed out some of the things to be avoided and others that are to be overcome in the work. He was followed by Messrs. P. D. Wagoner, of Long Island City; Frank J. Stone, of Philadelphia; W. H. Blood, Jr., of Boston, and George H. Jones, of Chicago.

DECORATIVE STREET LIGHTING.

A paper on "Decorative Street Lighting," written by Mr. E. L. Elliott, of New York City, was presented in the absence of the author by Mr. V. R. Lansingh. A number of lantern slides were projected on the screen showing different types of posts for decorative lighting. Mr. Lansingh discussed this paper briefly.

ORGANIZATION AND FUNCTIONS OF A SALES DEPARTMENT.

Thursday morning the commercial session took up the paper by Mr. T. I. Jones, of the Edison Electric Illuminating Company, Brooklyn, on "The Organization and Functions of a Sales Department." The scope of this paper is well described by its title. It gave the author's ideas as to the scheme of organization which should be pursued, the responsibilities of the various men, and the relation of the commercial department to other departments. In discussion, Mr. E. W. Lloyd, of Chicago, told of some of the methods used there. Mr. L. R. Willis, of Boston, said the Boston organization was similar to that of Mr. Jones, in Brooklyn. Mr. H. J. Gille, of Minneapolis, referred to the difficulty of getting the right kind of men. Others discussing this paper were Messrs. Parker H. Kemble, of Brooklyn; C. N. Stannard, of Denver; M. C. Osborn, of Spokane; E. M. Podeyn, of Brooklyn; M. W. Offutt, of Schenectady; M. O. DellPlain, of Syracuse; F. D. Pembleton, of Newark, N. J., and J. R. C. Long, of Leavenworth, Kan.

NATIONAL ADVERTISERS.

A paper by Mr. Frank B. Rae, Jr., of New York, entitled, "A Plan to Interest National Advertisers in Electric Publicity," was read by Mr. P. S. Dodd, of Cleveland. The plan included a compilation of information from central-station companies as to possible locations for large signs, rent of space, rates for electricity, number of people passing each day, and other information to be compiled in one book for the use of national advertisers. The plan also includes the personal solicitation of national advertisers by a man employed by the association and the circularizing of these advertisers. Mr. E. L. Callahan, of H. M. Byllesby & Company, Chicago, told of the difficulty in getting national advertisers interested in smaller cities, and moved to refer this plan of Mr. Rae's to the executive committee of the association for action. Mr. H. I. Markham, general manager of the Federal Sign System endorsed this plan. He called attention to the fact that it takes a heavy building to support a large signs and that sometimes investigation proves that locations thought to be suitable for signs are not so suited. Mr. M. S. Seelman, of Brooklyn, also spoke in favor of the motion.

INDUSTRIAL LIGHTING.

A paper illustrated with lantern slides on "Industrial Lighting with Incandescent Lamps," by Messrs. S. H. Hall, J. M. Hoyt, and Paul Bauder, of the National Electric Lamp Association, Cleveland, was then presented. It illustrated a number of antiquated and improved methods in factory and shop lighting. Mr. H. J. Gille, of Minneapolis, said this paper should be taken home and studied. The session then adjourned.

PROMPT EXECUTION OF ORDERS.

Thursday afternoon the last or fourth commercial session was opened by a paper by Mr. C. N. Stannard, of the Denver Gas & Electric Company, on "The Prompt Execution of Orders." This dealt with the importance of eliminating as much as possible of the time and red tape required in carrying out connect-up and repair orders in a large company. This was discussed by Messrs. Paul Doty, of St. Paul; C. V. Hare, of Philadelphia; M. C. Osborn, of Spokane; Douglass Burnett, of Baltimore; Robert W. Clark, of Minneapolis; M. S. Seelman, of Brooklyn; M. O. DellPlain, of Syracuse, and James T. Hutchings, of Rochester. All realized the importance of reducing the time taken to carry out orders, and many gave specific suggestions as to how this time had been reduced.

ELECTRICITY IN IRRIGATION WORK.

"Electricity on the Farm and the Influence of Irrigation from the Central-Station Standpoint" was the subject of a paper by Herman Russell, of the Rochester Railway & Light Company. This told of the work around Rochester in furnishing energy to farmers for pumping to irrigate fruit crops during dry portions of the season. Mr. M. S. Seelman, of Brooklyn, moved that a copy of this paper be sent, with a suitable letter, to all the agricultural journals, which would no doubt be interested in it. Mr. C. W. Pendell, of Chicago, and Mr. M. C. Osborn, of Spokane, speaking on this motion, advocated the elimination of the mention of a specific rate.

CAUCUS OF COMMERCIAL SECTION.

Thursday afternoon immediately following the fourth commercial session, the session resolved itself into a caucus for the formation of a commercial section of the National Electric Light Association. Mr. George Williams, of the Doherty Operating Company, New York, called the caucus to order, and Mr. John F. Gilchrist, of the Commonwealth Edison Company, of Chicago, was elected temporary chairman. Mr. George Williams explained the advantages of forming such a section with officers to take charge of the commercial sessions of future conventions. He was followed by Messrs. T. I. Jones, of Brooklyn; Frank B. Rae, Jr., of New York; H. J. Gille, of Minneapolis; C. V. Hare, of Philadelphia; M. S. Seelman, of Brooklyn, and others. On motion of Mr. C. N. Stannard, of Denver, it was voted to form a commercial section. On motion of Mr. H. J. Gille, of Minneapolis, the chair was instructed to appoint a committee to formulate plans and submit them to the executive committee of the National Electric Light Association. The chairman appointed such a committee as follows: Mr. George Williams, of the Doherty Operating Company, New York, chairman; Messrs. T. I. Jones, of Brooklyn; L. D. Gibbs, of Boston; C. W. Lee, of New York; Frank H. Gale, of the General Electric Company; M. C. Rypinski, of the Westinghouse Electric & Manufacturing Company; J. E. Becker, of New York; H. C. Mohr, of Philadelphia; E. W. Lloyd, of Chicago; E. L. Callahan, of H. M. Byllesby & Company; J. Robert Crouse, National Electric Lamp Association, Cleveland; V. A. Henderson, of Memphis; H. J. Gille, of Minneapolis, and C. N. Stannard, of Denver. The caucus then adjourned.

FINAL SESSION.

The final session began on Friday morning with a report by the Committee on Preservative Treatment of Poles and Cross Arms by Mr. W. K. Vanderpoel of Newark, N. J. This voluminous report relates to various preservative processes and recommends precaution in selecting a method from the many good, bad and indifferent ones advocated by various interests. The report was presented in abstract and at its conclusion Mr. Vanderpoel said that another committee would have to work up certain details with regard to costs and also details of plant construction. In discussing the paper, Mr. Farley Osgood brought out a number of suggestions which might be taken up by a subsequent committee and referred to some of the excellent features of the report of value to central station men. Prof. Hermann von Schrenk, supervisor of timber preservation of various railroad lines in the west was invited to join in the discussion and commended the general attitude of the committee as expressed in its report. He emphasized that the timber preserving industry is a technical industry and suggested that all associations interested in the matter of wood preservation should act together in order to obtain the best results. Questions were asked about the various processes by Messrs. W. E. McCollough of Beardstown, Ill., F. R. Cutcheon, R. J. Irvine of Marshall, Mo., and Leonard Fitzgerald of Gary, Ind., which were replied to by Mr. Vanderpoel.

AMENDMENTS TO THE CONSTITUTION.

The Committee on Amendments to the Constitution then presented its report. The amendments deal with changes in the method of assessing company membership fees and the formation of geographical sections.

ELECTION OF OFFICERS.

Next followed the report of the Nominating Committee which recommended the following officers: President, Mr. W. W. Freeman of Brooklyn; first vice-president, Mr. John F. Gilchrist of Chicago; second vice-president, Mr. Frank M. Tait of Dayton. Executive Committee—Messrs. Alex Dow of Detroit, H. A. Wagner of Baltimore and W. C. L. Eglin of Philadelphia. The Nominating Committee also recommended to the Executive Committee the appointment of Gen. George H. Harries of Washington, D. C., as treasurer and Mr. T. C. Martin of New York as secretary. On motion of Mr. Farley Osgood the report and recommendations of the committee were accepted and the secretary was directed to cast the ballot. Messrs. Farley Osgood and J. E. Montague, both heavyweights, were appointed as a committee to escort the newly elected president to the platform. In relinquishing the office Mr. Frueauff predicted that under Mr. Freeman's leadership the association would make great strides forward.

President-Elect W. W. Freeman.

President-elect Freeman in reply expressed his appreciation of the honor bestowed upon him and remarked that if this honor could be divorced from the responsibilities that go with it, there would be as many candidates as members of the association. However, the responsibilities must be accepted with the office and they are indeed very heavy. He expressed his appreciation also of the work performed by his predecessors Farrand, Eglin and Frueauff and announced his intention of following the methods introduced by them. The watchwords for the year will be "organization" and "cooperation" and he requested the effective cooperation of the membership.

PRESIDENT-ELECT W. W. FREEMAN.

Mr. Weldon Winans Freeman, the president-elect of the N. E. L. A., is vice-president and general manager of the Edison Electric Illuminating Company of Brooklyn, N. Y. Hard work and uncompromising honesty have drawn to him merited honors far greater in number than a man of his years would ordinarily be supposed to possess. Twenty years or so ago he was a stenographer in the office of the general manager of the lighting company of which he is now the executive officer. Mr. Freeman was born of British parents at Exeter, Ontario, on June 8, 1872. His early education he received in the grammar and high schools of Listewel, Ontario and in 1889 he went to Brooklyn and entered the service of the Edison Electric Illuminating Company of Brooklyn in the capacity above noted. He rose to the position of private secretary to the general manager and then by steady leaps became assistant secretary, then secretary, treasurer and finally vice-president and general manager. In the latter position Mr. Freeman is the active head of the concern with full responsibility, the president being an unsalaried official without active duties. His promotion carried with it similar promotion in companies allied with the Edison company, and in addition Mr. Freeman as a private individual has acquired interests in other concerns. Besides his most important executive position, Mr. Freeman occupies the following stations: Vice-president and general manager of the Kings County Electric Light & Power Company; vice-president and general manager of the Amsterdam Electric Light, Heat & Power Company; president of the Edison Construction Company; treasurer and director of the Electrical Testing Laboratories; past president of the Association of Edison Illuminating Companies; director of the Electrical Show, Inc. He is a member of the following societies: American Institute of Electrical Engineers, Illuminating Engineering Society, New York Electrical Society, Manufacturers' Association of New York, Brooklyn League, and the Canadian Society of New York. In social life he is represented by membership in the following clubs: Brooklyn, Crescent Athletic, Union League of Brooklyn, Long Island Automobile, Masonic Club of Brooklyn, Engineers Club of New York, Congregational Club of Brooklyn and the Belle Terre Club of Port Jefferson, L. I. In most of these he takes an active part, especially the Congregational Club of Brooklyn of which he has been president. He married Miss Ellen Burrows of Brooklyn in 1895 and is the father of a daughter and two sons.

FINAL PAPERS.

Upon motion of Mr. J. E. Montague, it was decided to appoint a committee of seven of which Mr. S. E. Doane will be one, to carry out the suggestion made by Mr. Doane relating to the revision of rates, to take care of the condition created by the introduction of high-efficiency lamps.

The report of the insurance expert, Mr. W. H. Blood, Jr., of Boston, was then presented. The report gives statistics to show that the rates now paid for insurance by central stations are at least twice as high as the risks involved, justify.

A paper by Mr. R. D. DeWolf of Rochester on "Decentralized Plants," calling attention to the advantages that may be derived by central stations from the operation of all isolated plants in the neighborhood was next presented, but not discussed.

Dr. E. P. Hyde, president of the Illuminating Engineering Society was introduced and described the lecture course to be offered this fall under the joint auspices of the Illuminating Engineering Society and Johns Hopkins University. There will be 36 lectures in the course which begins Oct. 26 and ends Nov. 8.

Mr. W. L. Waters' paper on "Direct-Current Turbo-generators" was next read. In it the author outlines the difficulties encountered in building high-speed commutators, and stated that direct-current turbo-generators are now available in ratings up to 300 kw. There was no discussion on the paper.

The committee on the President's address consisting of Messrs. Samuel Insull of Chicago, C. L. Edgar of Boston and M. C. Osborn of Spokane presented its report. It expressed high appreciation of the services rendered to the organization by Mr. Frueauff and it suggested that the methods pursued by him be continued during the next year.

Mr. T. C. Martin as the committee on memorials briefly outlined the memorials for the year relating to members who have died during that period, calling particular attention to the loss sustained by the association in the deaths of Messrs. George F. Porter, D. O. Mills, Jotham Potter and H. C. Butte.

Mr. W. H. Sparks of Louisville then presented a brief recording some of his impressions of the meeting and Mr. Irvine president of the Missouri Association, thanked the association for meeting in Missouri. At the close of the convention the Committee on Resolutions of which Mr. Arthur Williams was chairman, presented an extensive list of resolutions relating to assistance rendered by numerous companies and individuals tending to insure and increase the success of the convention.

Thanks were extended to the editorial staff of the *Convention Daily*, consisting of Messrs. T. C. Martin, W. E. Keily, D. H. Braymer, H. C. Cushing, Jr., E. Ehrlich, F. B. Rae, Jr., H. Riddell, G. A. Wardlaw, H. W. Young and O. H. Caldwell. Thanks were also extended to Capt. Robert McCulloch, president of the United Railways Company of St. Louis; Mr. Alten S. Miller, president of the Union Electric Light & Power Company; Mr. John M. Connelly of the press bureau of the association; the editors of the St. Louis daily press; the Class D members, the officers of the association including Messrs. Frueauff, Freeman, Gilchrist, Tait and Martin and to Mr. Charles H. Hodskinson, master of transportation. The convention then adjourned.

CONVENTION NOTES.

The Pennsylvania Geographical Section of the N. E. L. A. held a meeting on Thursday afternoon and decided to hold its convention at Glen Summit Springs, Pa., Sept. 14-16, 1910.

The vaudeville show at Delmar Garden on Thursday evening was largely attended. Some there were who said it was fine; others said it was fair, while still others maintained an ominous silence. The one real thing was said to be Mr. Harry C. Rice, who carried off the honors of the evening with a clever monologue.

Dr. E. P. Hyde, president of the Illuminating Engineering Society, is enthusiastic over the course of lectures to be given at Johns Hopkins University in October, the time of the Illuminating Society convention, elaborate plans for which have been under way for some time. Formal announcement of the course was made by him before the convention on Friday.

Although the association is composed largely of men and companies having to do with the commercial features of the electric lighting business, yet many of the members proved their interest in purely engineering subjects by attending the sessions of the Technical Section. Seats were at a premium during the meetings of the section owing to the unexpectedly large attendance.

If the enthusiasm accompanying the presentation of the paper on "The Public and the Water-Powers" before the Transmission Section by the section's president-elect, Mr. H. L. Doherty, can be taken as a criterion, then the section is destined to prove extremely active during the coming year, and its work will adequately represent an important addition to the association's activities.

Papers relating to illuminating engineering formed no little part of the convention's program. In addition to the subjects of street, residence and industrial lighting, papers were read on several types of high-efficiency lamps, and the effect of such lamps on the central-station industry. The presentation of these several papers, together with the announcement by the president of the Illuminating Engineering Society of the course of lectures on illuminating engineering to be delivered at Johns Hopkins University, did much to increase the already large interest in this subject.

By choosing for the presidency men of energy and enthusiasm unhampered by any age limit, the association does not find itself in the predicament of the National Government with but one past-president. The N. E. L. A. possesses many past-presidents, none of whom is ready to be Oslerized. Of these Messrs. James I. Ayer, Samuel Insull, Henry L. Doherty, Louis Ferguson, Charles L. Edgar, Ernest H. Davis, William H. Blood, Jr., Arthur Williams and W. C. L. Eglin were in attendance. Messrs. Charles Huntley and Dudley Farrand were detained by reason of illness and Mr. J. Frank Morrison, the first president, sent his regrets.

Through the courtesy of R. E. Chubbuck, vice-president and general manager of the Illinois Traction System, who placed his private car at the disposal of Mr. J. M. Wakeman, a party of ladies and gentlemen attending the convention enjoyed a most delightful ride from St. Louis to Carlinville, leaving the Hotel Jefferson at 10 a. m. and returning at 3:30 p. m. Luncheon was served in the car, which is probably the most completely equipped electric car in the country, containing sleeping accommodations for six people, an observation platform, kitchen, dining-room, lavatory, recording instruments, office appliances, etc., men's buffet, and Creviston of the Illinois Traction System took charge of the party and looked after the comfort of everyone on board in excellent fashion.

State gatherings were more of a feature this year than ever before and it is probable that there will be more of them at future conventions. The Pennsylvania geographical section of the N. E. L. A. had permanent headquarters and gathering place in one of the Coliseum boxes near the main entrance. The Illinois central-station men in attendance took dinner together at the Rathskeller of the American Hotel on Wednesday.

One hundred men on one train, to say nothing of the officers of the company already on the ground, was the contribution of the Commonwealth Edison Company of Chicago. The special train of nine cars left Chicago Tuesday night and returned Wednesday. Twenty of these men were selected by the company and 80 were elected by vote of the Commonwealth Edison Company branch. Mr. A. P. Good, of the inspection department, was chairman of the transportation committee.

On Tuesday evening a rejuvenation of the Sons of Jove was held on the stage of the Coliseum, which was well adapted for the exercises and afforded plenty of room for the initiation as well as seating capacity for the members. Nearly 100 candidates were initiated, the following officials taking part in the exercises: Messrs. Homer Neisz, Samuel A. Hobson, H. R. Holland, H. C. Rice, Fred Johnson, R. M. Van Vleet, L. P. Philo, John T. Casey and J. G. Pomeroy. Through the courtesy of the Moloney Electric Company its booth was made the headquarters for the Jovians during the convention. After the initiation exercises a luncheon was served in the supper room below, covers for 300 being laid. At the feast Mr. Frank L. Perry acted as toastmaster and introduced a number of old members as well as new ones, calling on them for impromptu speeches. These added not a little to the jollification of the evening.

The first session of the convention served to prove that the acoustic properties of the assembly hall were not such as to allow a speaker to be heard by any of those not seated within a few rows of the speakers' desk. Use was made of an elevated platform formerly employed as a stage for an opera company, and separated from the main auditorium which during the convention served as the exhibition hall, through the intervention of a drop curtain. Throughout the first session most of the sounds reaching the ears of those in the rear of the meeting room came from the booths of exhibitors who displayed apparatus in working condition. Between the first and the second session remarkable improvements were introduced. Wires were erected so as to radiate fan-like from a point over the speakers' desk to various pillars around the rear of the room, an improvised sounding board was arranged so as to be occupied by each person when addressing the audience. The changes proved highly successful and no more trouble was experienced either from a superabundance of extraneous sounds or a deficiency of sounds from within.

One of the features of the convention was the publication, under the auspices of the association, of a *Daily Bulletin*, which was issued at the expense and through the co-operation of seven electrical journals, from whose editorial staff the editors who conducted the *Bulletin* were detailed. The matter contained related almost exclusively to the routine and other work of the convention, the exception being some columns daily of personals and notes under the head of "Conventionalities." The paper was printed during the night and distributed early in the morning, so that at breakfast the convention visitors could glance over

the list of latest arrivals reported and make note of happenings of the previous day at which they were not present. Each issue contained also a concise account of all the meetings of the preceding day, including characterizations of the papers presented and of the following discussions. The warm vote of thanks voted by the association to the editors expressed the feeling of all in attendance at the convention of the admirable manner in which they conducted the *Bulletin*, with respect both to the kind of matter contained and the good taste in which it was presented.

Some three or four months ago, the Accounting Committee of the Association sent a circular letter to each of the member companies of the association, asking for complete sets of the forms used in conducting their business. Some 150 companies complied with the request of the Committee and in all, about 10,000 forms were collected. For six weeks previous to the convention, a number of clerks under the direction of Mr. T. C. Martin were engaged in arranging these forms in departmental order. The result was a collection of 24 large scrap books displayed at the right of the main entrance to the Coliseum with heads as follows: Power house reports, power house data, batteries, meters and transformers, meters and motors, arc and incandescent lamps, connection and trouble, instruction, distribution of accounts, specials and books (being collection of monthly report forms), trial balances, consumers' ledger, consumers' cards, collections, labor, pay-rolls, new business, purchasing, store room. This is the beginning on the work of producing a uniform system of central-station accounting. The benefit of such a system is almost inestimable and it is hoped that the interest shown in the exhibit is indicative of the interest that the members will take in producing such a system. The exhibit was visited by a number of managers and accountants of the various member companies and much appreciation was expressed of the work done by the committee. The exhibit was in charge of W. D. Barnes, of St. Louis.

Mr. Charles H. Hodskinson, the newly appointed master of transportation of the National Electric Light Association, was born in Salem, Mass., Aug. 20, 1874, and received his education in the public schools and at Salem Commercial College. He entered the employ of the Edison Electric Illuminating Company, Boston, in 1892 at the bottom of the ladder, and has steadily advanced in that progressive company up to his present position on the executive staff of President Edgar. Mr. Hodskinson took part in the organization of the New England Section of the National Electric Light Association, and was its first secretary and treasurer; at the present time he is a member of the executive committee of the section for the State of Massachusetts. Mr. Hodskinson became New England manager of transportation in 1904, and it was largely through his efforts that the New England delegation to the National Electric Light Association conventions has always been a large one. Upon the sudden death of George F. Porter, about a month ago, he was appointed to his present position, and can boast that not a single special train was late in arriving at St. Louis.

Mr. C. H. Hodskinson

Near the entrance to the Exhibition Hall as a supplement to its admirable report, the Meter Committee made a very interesting exhibit of meters, protective devices, seals, loads, etc. On one side was apparatus used in series loading such as carbon rheostats, wire rheostats, water rheostat, and a dimmer. Shunt loading devices were shown on another table. On this were arranged load batteries, various types of low-voltage transformers and a complete set of meter-testing forms used by representative central-station companies. On the wall was shown a typical tool kit while along the wall were shown all the modern meter protective devices on the market. The connection blocks on most of these permit of all kinds of tests and substitution of meters to be made without interfering with the supply of energy to the customer; and all of them safeguard the central-station company against theft of energy.

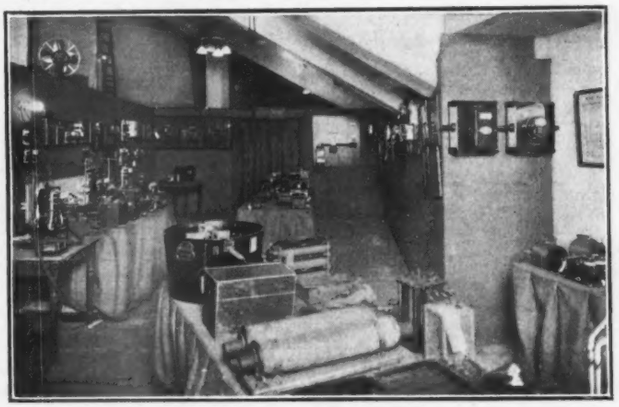


Exhibit of the Meter Committee

Standard instruments for use with rotating test meters and indicating instruments for both alternating and direct-current service were also on view, together with switching devices for stopping and starting purposes. For the purpose of indicating the practice of large companies, a test table similar to that utilized by large companies was exhibited. Above the table was a device for testing the accuracy of a meter either lagged or non-lagged. The lagging coil was so placed that the operation of meter under either condition might be readily ascertained. Contributions to the exhibit were made by the Edison Electric Illuminating Company of Brooklyn; John Pratt Company, of Hartford, Conn.; Potomac Electric Power Company, Washington, D. C.; Helios Manufacturing Company, Philadelphia, Pa.; Public Service Corporation, Newark, N. J.; Sangamo Electric Company, Springfield, Ill.; General Electric Company, Schenectady, Pittsfield and Lynn; Duncan Electric Manufacturing Company, Lafayette, Ind.; Rochester Railway & Light Company, Rochester, N. Y.; Edison Electric Illuminating Company, Boston, Mass.; H. J. Blakeslee, Syracuse, N. Y.; Excess Indicator Company, New York; Westinghouse Electric & Manufacturing Company, Newark, N. J.; New York Edison Company; Ft. Wayne Electric Works, Ft. Wayne, Ind.; United Electric Light & Power Company, New York City; Weston Electrical Instrument Company, Newark, N. J.; Philadelphia Electric Company and Buffalo General Electric Company.

One of the most instructive exhibits at the convention was that of the Question Box at the rear of the Exhibition Hall. Nine large water-colored charts mounted on cardboard told the story graphically of the growth of the Question Box from its beginning and gave many other interesting data. Mr. John C. Parker, the editor, was the originator of the set of charts which showed in a very striking manner the statistics of the work. Mr. H. O. Stewart of the engineering department of the Rochester Railway & Light Company had charge of the exhibit. The charts indicated what the Question Box is doing for the members of the N. E. L. A. and what the members are doing for the Question Box. The key chart No. 0 showed in colors 27 general classifications of subjects, each kind of question, such as boilers, underground lines, electric cooking and heating, etc., being given a color. Chart No. 1 showed the distribution of interest by per cent of questions on a subject. As the horizontal co-ordinates time by months since August, 1907, was taken, and for the vertical co-ordinates per cent of question by subjects. Chart No. 2 indicated the dis-

tribution of interest by per cent of answers on subjects over a period from August, 1907, to the present time. In Chart No. 3 were pictured the number of questions by subjects (cumulative), also extending from 1907 to 1910 and representing by the vertical height the number of questions on each subject. There were about 99 questions on meters alone which was the greatest number for any one subject.

Chart 4 indicated the number of answers by subjects (cumulative) extending over a like period; the total number of answers over the whole period reaches about 1500. The meter questions had the lion's share with 275 answers; transformers came next.

Who answered the most questions is shown in Chart 6, which plotted the number of answers of 51 of the largest contributors. W. R. Collin headed the list with 30 answers, next came W. G. Claytor with 30, then G. D. Gratton with 15; then they were graduated down to the last 20 who answered four questions apiece.

In Chart 7 was given the number of questions by subjects in Vol. 3 of the Question Box. As in the case of the charts covering the whole period the meter questions showed the preponderance, there being about 63 in all. Then followed the number of answers per question by subjects, in Vol. 3, as shown in Chart 8. They ranged all the way from about 3.65 for legal questions down to about 0.5 for electric cooking and heating apparatus.

A peculiar feature was shown with regard to meter questions. As shown in Chart 1 and reflected also in Chart 3, the questions on meters were heaviest during the winter months, being very light in the summer and early fall. The only explanation for this seems to be that during the winter when the load is heaviest the most trouble arises in the meter department.

The remaining chart, No. 5, showed a map of the United States and from the markings upon it the distribution of interest, geographically, is readily calculated. As the center of operations Mr. Parker took Rochester, N. Y. Around it he drew consecutive circles 250 miles apart, then taking the number of answers from the largest companies only he spotted these numbers in their proper locations all over the map. The largest number of answers in any one circle came within the 250-mile radius from Rochester and by far the greater bulk of all the questions came within the 500-mile circle.

The purpose of the Question Box has been to stimulate association work by infusing loyalty in the employees of the various central-station companies and to promote a general spirit of helpfulness and interest in the association. The Question Box exhibit was visited by a large number of people and judging from the various remarks made most of the visitors had at some time or other received very valuable aid and information by this means.

CURRENT NEWS AND NOTES.

Safe for Radium.—The Chubb Company has built for the British Radium Corporation a safe which will hold 100 lb. of radium valued at $5,000,000,000. The safe is both burglar-proof and emanation proof. To prevent the escape of emanation a 3-in. wall of lead is built inside the steel shell and means are provided for collecting the emanation before the safe is opened.

Electric Thief Trap.—A locker thief was trapped at Brown University by a clever electric alarm. A pocketbook inserted in the jaws of a spring contact, the terminals of which were carried to an alarm in a nearby office, was placed in a trousers pocket and the wires concealed. The removal of the purse closed the circuit and announced the theft, and the thief was caught red-handed.

Photometric Standards.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held on Thursday, June 9, two papers will be presented: "Photometric Units and Nomenclature," by Dr. E. B. Rosa, and "Incandescent Electric Lamps as Secondary Standards of Luminous Intensity," by Messrs. Clayton H. Sharp and Preston S. Millar. The annual election of officers will be held on the same evening.

Richest Tungsten Deposits in Washington.—It has been claimed by experts who have examined the tungsten deposits in the Dur Park district, Stevens County, Washington, that these will be developed in the next 12 months to the richest mines in the world. The Germania Mining Company has been operating in the district for about two months. Its workings show a quartz vein having an average width of 2 ft., well mineralized throughout with tungsten in the form of wolframite, with occasional shoots of high-grade ore. Five grades of concentrates, running in value from 58 to 74 per cent in tungstic acid, are produced.

Employers' Liability Bill.—Governor Hughes has signed Assemblyman C. W. Phillips' bill amending the employers' liability law, and providing a voluntary compensation scheme. The assumption of risk rule is modified so that if an employee continue in his work after discovering defects or violations of law by the employer he shall not be barred from his right of action. It modifies the fellow-servant rules by making the employer liable for the negligence of a person exercising any superintendence and for the negligence of a person entrusted with authority to direct, control or command any employee in the performance of the duty of such employee. The bill changes the burden of proof as to contributory negligence so as to require the employer who has been proved negligent to assume the burden of proving the contributory negligence of the injured employee. It also contains a provision intended to prevent an employer from escaping liability for defects in his plant by employing a contractor or sub-contractor. The voluntary compensating scheme may be established by consent of the employer and any of his employees. After the filing of such consent the employer is relieved from liability under the employers' liability act and becomes in place thereof liable for all injuries to such consenting employees and for the compensation provided for by the bill.

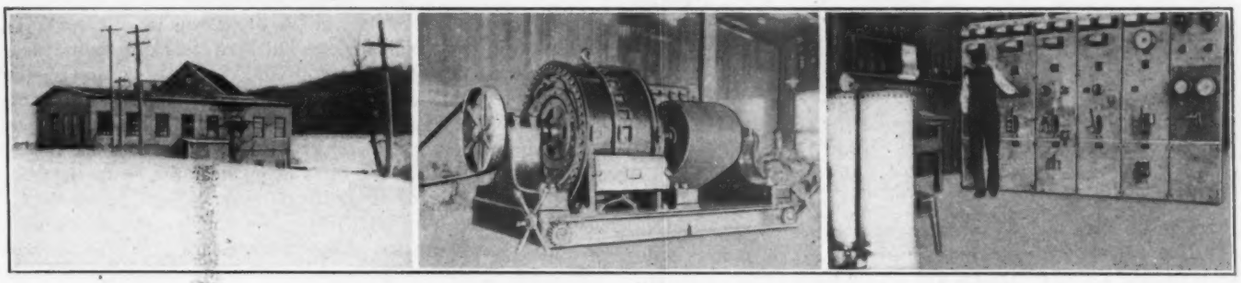
A. I. E. E. Electric Show.—The Montana State College Branch of the American Institute of Electrical Engineers gave its third annual electrical show in the laboratory and drafting rooms of the electrical department on the afternoon and evening of May 20. Approximately 2000 people were in attendance. In addition to the apparatus belonging to the department, several manufacturing companies had their products on exhibition, as follows: General Electric Company, tungsten and tantalum lamps, small motors, electric lighting fixtures, electric household appliances; Westinghouse Electric & Manufacturing Company, cooking and heating appliances; Benjamin Electric Company, electric lighting fixtures. The American Vulcanized Fiber Company had an exhibit of its manufactures, and also the National Metal Moulding Company. The Madison River Power Company, Butte, Mont., had an electric kitchen installed, with a demonstrator at work. The photograph gallery, where colored photos were taken, received a good deal of attention during the progress of the show. A heavy chair with a sheet-iron diaphragm bottom had been fitted up with a large electromagnet underneath in such a way that on closing a switch in the alternating-current circuit a tremendous noise and vibration was set up, at once startling to the subject who had been persuaded to sit for a picture and amusing to the spectators. The Montana State College is located at Bozeman, Gallatin County, Mont., and has an annual enrollment of about 400 students. Courses are maintained in civil, electrical, mechanical, sanitary and chemical engineering, chemistry, physics, mathematics, history, literature, pharmacy and the various branches of agriculture. One day each year is set apart for the entertainment of visitors and the electric show is the principal feature of the entertainment. The show is marked by an increasing attendance each succeeding year. Labor-saving electrical devices receive special attention from a large number of people.

HOUSATONIC RIVER HYDROELECTRIC PLANTS.

Examples of Early and Modern Methods of Hydroelectric Development.

By J. FRANZ.

THE Housatonic River rises in the Berkshire Hills of Massachusetts, running southward into Connecticut, and emptying into Long Island Sound. The river is nearly 150 miles long, and traverses a hilly country abounding in scenic beauty. It has a good average flow of water throughout the year. All along its course have been developed large cotton and paper industries, which use the water-power derived from this stream. Where the Housatonic River passes through the lower part of Berkshire County it forms the famous Housatonic Valley, and here are located two splendid hydroelectric plants, owned and operated by the Monument Mills Company.

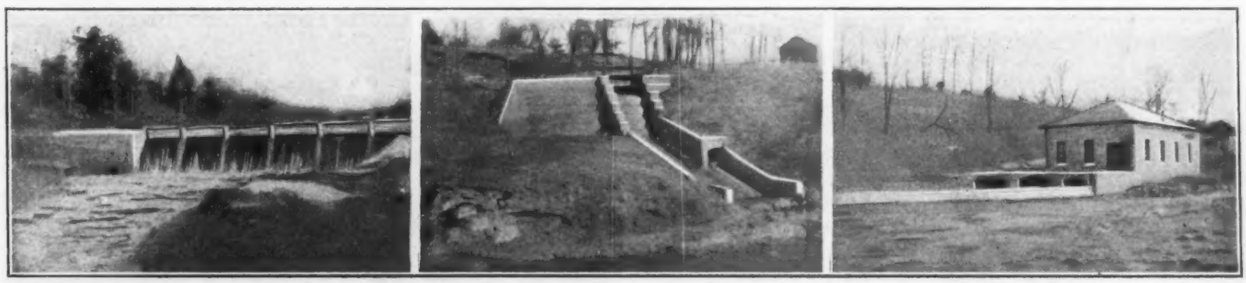


Figs. 1, 2 and 3—Power House, Generator and Switchboard at Old Plant.

The first electric plant was erected in 1894, a wooden dam, 20 ft. high and 140 ft. long was thrown across the river and impounds sufficient water to develop about 800 hp. The station is a wooden structure, and houses two generators, one rated at 240 kw and the other rated at 280 kw. Both generators are of the S. K. C. type. The smaller unit is of especial interest, as it was the first machine of this type made by the Stanley company, so far as the writer is aware, and much of the original practical experimenting was done in this station. In 1898 the business assumed such proportions that it became necessary to install a second unit, which was quite an improvement over the first and was designed with sufficient ventilation. The old unit, as one of the attendants expressed it, is a splendid stove, and with the aid of a small coal stove sufficed to keep the station comfortable during the severe winter weather which prevails in the Berkshire Hills. Despite this disadvantage, however, the machine has given satisfactory results for the past 12 years and has needed no repairs. Each unit is belt-connected to a 350-hp McCormick horizontal turbine, built by the Holyoke Machine Company, and regulated by governors manufactured by the same firm. The exciters are also belt-driven, and are rated at 3 kw and 5 kw, respectively, the latter unit being compound wound, and both being products of the Crocker-Wheeler Company. The smaller main generator is designed for a speed of 800 r.p.m., and the larger machine operates at 500 r.p.m. Both are two-phase, 66-cycle induction-type machines wound for 2400 volts.

Many changes have been made in the switching apparatus, and a few years ago an entirely new switchboard was installed. This consists of two generator panels, one exciter panel and three feeder panels. The exciter panel has also a sectionalizing switch which divides the buses, and thus either or both machines in multiple can be used to supply the feeders. The board is of standard design, and was built by the former Stanley Electric Company. The station is also equipped with a rain gage, so that a record can be kept of the rainfall. A four-wire No. 0 bare-copper line leaves the station and connects with a trunk line on the opposite side of the Housatonic River, consisting of a No. 2 insulated-copper three-wire line running to the plant of the Great Barrington Light & Power Company, four miles down stream. This company also operates an auxiliary steam station. The street and residence lamps in districts contiguous to the station are fed from two No. 6 insulated copper lines.

The company developed so rapidly that soon the need for more power was felt, and a second station was built a mile and a half up stream in 1906. The dam across the river at this point is built of concrete, and is 125 ft. long and 28 ft. high. A canal 1500 ft. long leads to the headgates, and from here to the station there is a fall of 41 ft. The maximum capacity available at the station is estimated to be 3000 hp, and at minimum flow the available head is sufficient to yield 1500 hp. The penstock is 8 ft. in diameter and is made of boiler iron. Four inlets are provided into the station, which is a stone and concrete structure. At the present time there is but one 600-hp McCormick turbine installed. This is direct-connected to a 500-kw, revolving-field Stanley generator, the exciter for which is belt-connected and located on the opposite side of the turbine governor. The generator has a speed of 286 r.p.m., and its characteristics are similar to those of the machines in the other station.

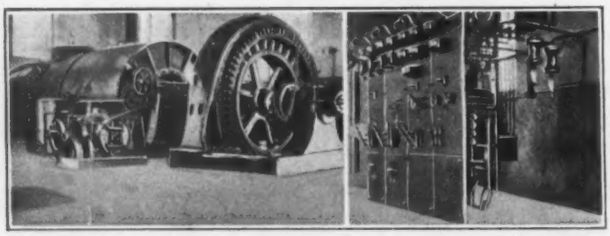


Figs. 4, 5 and 6—Views of New Development.

The switchboard in the new station is made up of one exciter panel, one generator panel and two feeder panels. There are two sets of busbars, and the switches are of the bolt-lock type. This arrangement of switchgear permits the generator to feed the outgoing lines separately, and also to operate in multiple with the other units in the station lower down the river. Two four-wire lines are run from the station; one No. 4 bare-copper line constituting the company's trunk line and supplying the mill with energy and a No. 6 insulated-copper line feeding energy to the Stockbridge Lighting Company.

This company operates in a village of about 2000 inhabitants and is two miles distant from the station. Its entire output is used for lighting. Nearly all of the energy generated is used during the day by the two cotton mills owned by the company, which owns the hydroelectric stations, and at night the output is sold jointly to the Stockbridge Lighting Company and the Great Barrington Light & Power Company.

The motor installation of the mills fed from the hydroelectric plants consists of an aggregate of 645 hp in induction motors and 355 hp in synchronous motors. These drive groups of machinery such as are customary to the cotton industry. Besides nine induction motors, having an aggregate of 500 hp,



Figs. 7 and 8—View of Turbo-Generator Unit and Switchboard.

there is in Mill No. 1 a 75-hp synchronous machine and in Mill No. 2 there is, in addition to five induction motors with an aggregate rating of 145 hp, one 180-hp synchronous machine. The synchronous machines are belted to lines of shafting in the basement floors, to which are also connected two 300-hp turbines driven from the water-power of each mill. These synchronous machines are used to improve the power-factor and are employed either as motors or generators, depending on whether there is a large supply of water or not. Ordinarily the motors are started and brought up to synchronous speed by means of the turbines. In the synchronous-motor room of Mill No. 1 there is also installed a 7½-kw constant-current transformer and panel, from which the street lamps of the village of Housatonic, in which the two mills are the chief industries, are supplied with energy.

A magneto call-telephone system connects all departments of the plant to the main office, which is located in a separate building. The company has a competent electrical engineer, and frequent tests are made on motors to determine under what load conditions they operate. Under each motor there is a card on which the oiler makes records of the time he oiled and inspected the motors.

HYDROELECTRIC DEVELOPMENT ON THE NIOBRARA RIVER.

Station at Valentine, Neb., for Supplying Energy to a Projected 128-Mile Single-Phase Railway.

By W. K. Palmer.

Among the most attractive enterprises of the present day in the field of industrial development are those connected with the generation, or development, and transmission of useful energy from flowing streams and falling waters, and the application of such energy to the needs of modern life. Of the various attempts of recent years to apply to useful purposes the available energy of a smaller stream, none presents more interesting features, both physically and commercially, than that being made near Valentine, Neb., on the Niobrara River.

The site of the hydroelectric installation is near the confluence of the Minnechaduza River with the Niobrara, not far from the site of the old Fort Niobrara, approximately 5 miles northeast of Valentine, Neb.; Valentine being approximately 300 miles by rail northwest from Omaha.

Upon first consideration of this project, it would appear that, however admirable might be the conditions physically for the construction of a dam, the impounding of waters and the continuous use of the stream for power purposes, there must be an utter absence of demand for energy, or suitable market, without which no enterprise could succeed, however meritorious it might be from a constructional and operating standpoint. From the standpoint of the usual standards set up for such enterprises it must be admitted that the apparent available market for energy is small.

How this apparently unsurmountable condition was confronted and overcome and every requirement of a commercially correct undertaking met by the originator of the undertaking, Mr. C. H. Cornell, of Valentine, Neb., will be recounted, presently, following a description of the engineering and constructional features of the project and an outline of the manner in which the special engineering problems met by the engineers were solved.

THE NIOBRARA RIVER.

The Niobrara River rises in the mountains of eastern Wyoming, flowing eastwardly through northern Nebraska to its juncture with the Missouri River in the northeast corner of the State at or near Niobrara City. This river comprises a drainage area of approximately 9000 square miles, which, being comparatively narrow in its upper portions, broadens as it approaches the Missouri, the flood plains near the headwaters being approximately 400 ft. above the river.

In its middle course this river runs through a canyon variously 100 ft. to 300 ft. deep, beyond which are high rolling table lands, cut by the deep canyons of many tributary streams. Bordering these table lands are rolling sand hills which cover large portions of the counties of Sheridan, Cherry, Brown, Rock and Holt. These hills were formerly of a shifting nature changing configuration with every wind, owing to the fineness of the sand, but in recent years more permanent, due to the increase of vegetation caused by the increase of rainfall.

The soil throughout the entire drainage area is very sandy, trees rare, and in the main, the country exceedingly barren except for the most meagre growth of grass. Precipitation throughout this drainage area may be estimated at from 18 in. to 20 in. annually, being from 15 in. to 18 in. in the upper portion of this area and 18 in. to 20 in. throughout the middle portion, including the location of the proposed development, and from 21 in. to 24 in. at the lower extremities of the stream. Evaporation is estimated at from 40 in. to 50 in. computed upon free exposed water area and at Valentine results of Government observations average 43.8 in. annually. According to reports

Fig. 1—Power House and Dam, Niobrara River.

this evaporation may at times amount to as high as 72 in., or 6 ft. About 70 per cent of the precipitation occurs in the months of April to August inclusive, about half of the remainder being snowfall.

The chief tributaries of the Niobrara are the Verdigris, Keya Paha, Snake River and Minnechaduza River. The drainage area of the Snake River is similar to that of the eastern portion of the Niobrara. Little damage is done by floods in the drainage area on the Niobrara for the reason that the sand hills forming a large portion of this area act as regulating reservoirs for the rain and snowfall, holding and feeding the waters of the stream as spring water, thus equalizing the flow and

producing a constancy of discharge that is remarkable and highly favorable to the utilization of this stream for power purposes. At the present time the water of the Niobrara is but little used, irrigation being practised to but a slight extent in the low flood plains and that in a small and crude fashion. A few small power developments exist in some of the tributaries, as for example, at Valentine, where a small dam has existed for many years furnishing power to a mill and for pumping water for the city. On the Snake River there are possibilities of power development, but owing to the total lack of market and excessively long transmission lines to deliver energy to any center of population, these are as yet commercial impossibilities. At a point near Valentine, just above the confluence of the Minnechaduza and Niobrara Rivers, there is found a set of conditions remarkably favorable for the construction of a

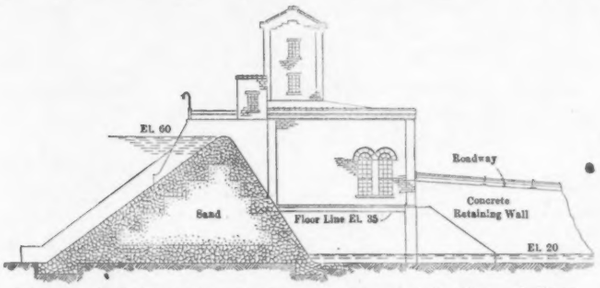


Fig. 2—East Elevation of Power House and Section of Dam.

dam and for the development of the power of the Niobrara River, and it is this location and the construction and installation of a hydroelectric station at this site, which it is the intention to describe herein.

THE DAM.

After a most painstaking and exhausting study of the conditions affecting the design and installation of an hydroelectric station on the Niobrara River at approximately the location chosen for the purpose, and following systematic surveys and calibrations of the stream and investigations of materials and formations encountered, the exact site for a dam was located and complete surveys made by a corps of engineers organized and maintained in camp for five weeks at the site of the proposed installation. The methods adopted and used for the

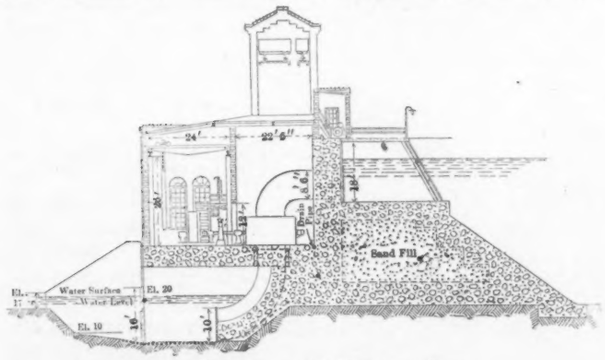


Fig. 3—Section of Station and Dam.

calibration of the stream are interesting, but as the present purpose is to describe the construction of the dam and the power station with its equipment and accompanying transmission lines, etc., this will be passed with the statement that this calibration was accomplished by a method of floats used successfully by the writer, hitherto, and that no unusual difficulties were encountered except those due to the very swift current in this stream. As to the dam itself, novel and interesting conditions are presented bearing upon the question of the type of dam best suited to the needs of the case.

It might be assumed at first that one of the familiar types of hollow reinforced concrete dams would, of course, be adopted for such an undertaking, the crest of the dam above bed rock being approximately 43 ft. As much as such a type of dam might seem desirable, the question of available materials for its construction determines that its cost would be prohibitive. There is absolutely no stone found in that section of the State suitable for making reinforced concrete, and no sand sufficiently near to the site which is sharp enough to use in such concrete. While there is sand everywhere and nothing but sand in the immense hills surrounding the site, this sand is of such a powdery character that it is entirely unfit for the use in question, and likewise, although there is an abundance of rock near at hand, it is of such a soft character that it would not be fit at all for the thin walls of a reinforced concrete structure. The fact that the ever-present sand of this locality makes a most excellent fill, falling into place immediately upon being dumped, without shrinkage, coupled with the consideration that the native soft rock may be used in the making of a mass concrete, has suggested the type of construction that has finally been adopted and incorporated in the plans.

Fig. 2 shows in addition to the station building the typical section of dam through the spillway; and Fig. 3 shows the modification of this section at the site of the station building, which is constructed as a part of and upon the dam, as fully shown in this drawing. It will be noted that a bed of mass concrete is first laid and then a sand core fill made and faced with the mass concrete of native stone. This would not be an allowable construction with any material less satisfactory than the native fine sand with its remarkable quality of settling with practically no shrinkage, being also clean. Extensive comparative estimates between all-steel dams, hollow reinforced concrete dams, earth dams with masonry cores, etc., satisfied the engineers that this construction, although possibly unusual, was justified, in view of the conditions found to exist.

Provisions are made for and care taken to secure a smooth and uninterrupted flow of the waters impounded back of the dam, through the station and through the wheels and out into the channel of the river below the dam. It is believed that much of the criticism which can justly be made on many such installations, as to the lack of a systematic way of disposing of the water after it leaves the turbines, and hence the troubles attending the eddying and backing up of the tail water, have been obviated in the present installation.

Fig. 4 shows a vertical elevation through the station in front of the generators and wheels, which, together with Fig. 5, will

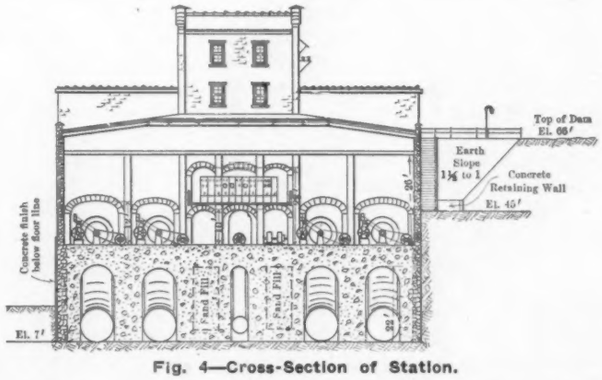


Fig. 4—Cross-Section of Station.

give a very clear idea of the features of this station, which, it is believed by the engineers, embodies the points most sought for in the design and construction of such a plant. Fig. 1 shows a perspective of the dam and power station and a bridge intended to carry a line of electric railway over the Niobrara River connecting Valentine with Fort Niobrara.

As to the materials of construction to be used for this station building, the same consideration and arguments were weighed as in respect to the construction of the dam, and native stone is used, in so far as possible, with a limited amount of special reinforced concrete construction, all of which is shown in the illustrations.

STATION EQUIPMENT.

Four main generating units are required, these being wound

three-phase, but having a normal rating of 1000 kva, when operating as single-phase generators, at 6600 volts, 25 cycles. As will be explained later the main consumer of energy will be a single-phase railroad, hence, the generators are used as single-phase machines. The water turbines are to be of the horizontal shaft, center-discharge, double-turbine type, enclosed in steel casings, with feed-pipe connections at the top as shown. The turbines will operate normally at ⅞ full gate opening under a head of 40 ft. from the level of head water to the level of water in the tailrace. The draft tubes are approximately 32 ft. long, and make a large radius bend so that the water is discharged in a horizontal direction. The turbine governors are of the oil-pressure, hydraulic type, and are electrically controlled from the switchboard.

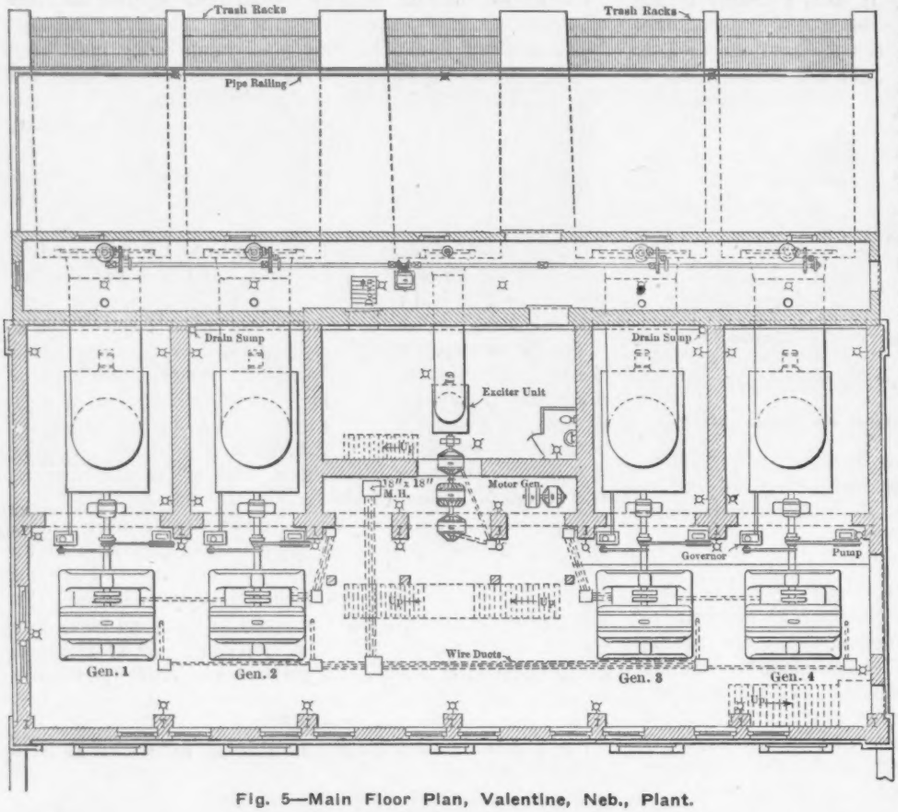


Fig. 5—Main Floor Plan, Valentine, Neb., Plant.

There are two 150-kw, 125-volt exciters, each being capable of exciting the fields of all four of the large generators. One exciter is driven by a three-phase, 25-cycle synchronous motor, and the other by a waterwheel. The shafts of the two outfits are lined up and the ends supplied with couplings so that the motor can drive either exciter, if necessary. The synchronous motor is employed to aid the power factor.

The switchboard consists of 11 panels, and is to be located on the balcony floor overlooking the generator room. The maximum tension on the switchboard is 125 volts.

A three-story tower extending out from and above the station proper contains the high-tension and low-tension busbar compartments, the transformers and lightning arresters, as well as the oil circuit-breakers. The low-tension circuit-breakers are of the remote-control, hand-operated type. The high-tension circuit-breakers are electrically operated.

The first floor of the tower contains the low-tension busbars and oil switches. The second floor contains the transformers. The third floor contains the high-tension busbar compartment, the electrically operated oil switches and the lightning arresters. thus the energy is transmitted continuously from generators to switchboard, to low-tension bus, to transformer, to high-tension bus and out to the line from near the top of the tower.

Two single-phase transformers, with a nominal rating of 2000 kva each, are to be installed. They are so arranged that either transformer can be cut out in case of emergency, and the load, reduced somewhat, can be carried on one transformer. The transformers are wound for a primary voltage of 6600 volts and a secondary voltage of 44,000 volts. Electrolytic type of lightning arresters are to be used.

A water rheostat is to be constructed in the Niobrara River so that the entire station load can be thrown on this rheostat in case the turbines tend to run away.

The question of the use of the energy here developed will now be discussed. As mentioned above, Valentine, Neb., is approximately 300 miles by rail northwest of Omaha. Spencer, Neb., is about 100 miles from Omaha in a northwesterly direction, but approximately 128 miles east of Valentine. Between the towns of Valentine and Spencer there is a large expanse of country and numerous towns which have no railroad facilities. The average annual value of crops in this territory is in the neighborhood of $2,250,000 and the value of live stock nearly as much more. Hence, the value of a railroad connecting these towns is at once apparent. It it not an interurban project with hourly service. Such a road would not pay. It is a project requiring a regular train schedule of perhaps two passenger and two freight trains a day each way and this is what has been considered. By this railroad a market is found for the energy from the station described above, and at the same time the cheap energy from this water-power station is of great advantage in the economical operation of the railroad. The use of electric locomotives is contemplated, hauling passenger trains of 4 to 6 cars, and freight trains of 20 to 30 cars. The transmission line will be single-phase and the locomotives will be equipped with complete single-phase apparatus. The entire engineering work for the two projects described above was done by the W. K. Palmer Company, of Kansas City, Mo.

ECONOMICAL SMALL ELECTRIC PLANTS.

By Warren H. Miller.

At Bertry, in France, there is a small central station plant, consisting of two superheated steam engine units of 50 hp each, driving alternators. There are over 1400 such small stations scattered over Europe and England and the economy of these small engines is remarkable, in some instances the specific consumption being 0.473 kg (1.04 lb.) of coal per hp-hour, and 3.93 kg (8.65 lb.) of steam per hp-hour.

Considering our long train of wastes of national resources, most of them entirely preventable, the small steam-engine plant is not the least among them. In the United States there are hundreds of thousands of small engines of from 20 to 200 hp, driving anything from an agricultural machine to a dynamo, and none of them doing much better than 5 lb. of coal to the actual brake hp-hour. This would be on a performance of 35 lb. of steam per hp-hour and, as a matter of fact, most of them do nearer 75 than 35 lb. per hp-hour. One is apt to consider a small 100-kw plant that operates with 30 lb. of steam per hp-hour and 4 or 5 lb. of coal per hp-hour a pretty fair specimen of practical operation, entirely aside from the cost of wages for firing and attendance. Yet this plant at Bertry, and over a thousand

like it, are jogging along on one-fourth this fuel consumption and housed in a single compact installation instead of the boiler-house and engine-room, as is standard with us.

The root of this enormous free-and-easy waste lies in the fact that, while Americans have neglected various possible economies in the manufacture of steam from coal and water, the Germans have gone ahead and reaped the just rewards of a more intelligent application of the ordinary means of making steam, in the infinitely better economy that they get with their small plants. It seems incredible that the mere neglect of such seemingly small matters as radiation, boiler feed, superheated steam and cylinder jacketing should result in such a tremendous difference in their favor. Decreased steam consumption means a reduction in the actual amount of steam generated and therefore losses up the stack and in the boiler feed pumps are greatly reduced. Assuming 20 per cent of the heat lost up the stack and allowing 5 lb. of coal per hp-hour, this loss is more than the German's whole fuel bill.

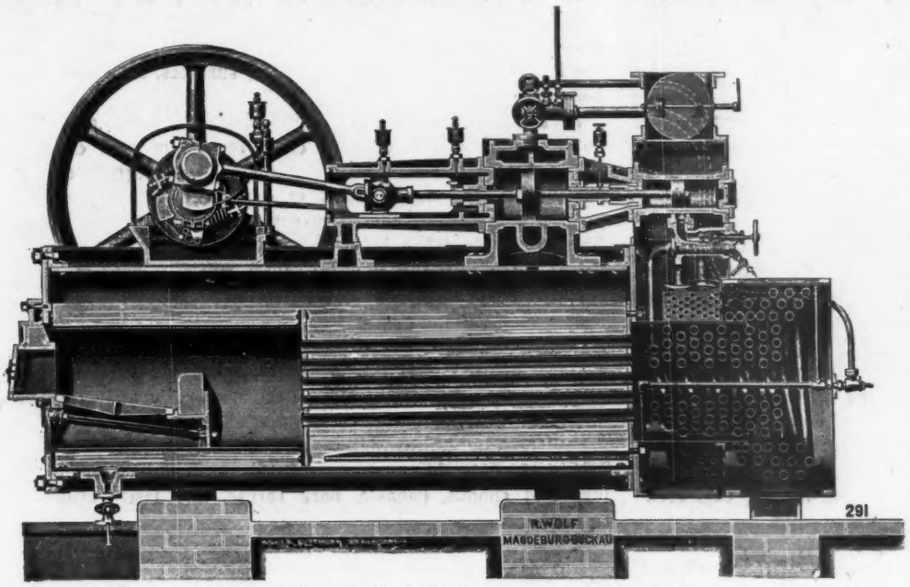


Fig. 1—Longitudinal Section of Locomobile Unit.

A sectional view of one of these machines is shown in Fig. 1. A study of this view will reveal the following facts: There are two superheated coils, one for the high-pressure cylinder and one for the low; the high-pressure cylinder is located in the chimney and the low-pressure cylinder is in the steam dome; there is no exposed steam piping; the boiler is fed by a pump, mechanically driven by an eccentric of the crankshaft; the internally fired, corrugated furnace, with airtight heat jacket surrounding the entire boiler. These dispositions of well-known elements lead to a remarkable economy of coal, equaling that obtained in the largest turbine installations, because every reduction in the demand for steam eliminates also the boiler losses which would be entailed in generating that steam. The Bertry engines use the steam at 170 lb. per sq. in., while the usual pressure in plants of this size in the United States is 80 lb. per sq. in. Furthermore, the steam is superheated to a temperature of 625 deg. Fahr.; it expands in the high-pressure cylinder down to 234 deg., is again superheated to 361 deg., and then expands down to 90 deg., the temperature of the condenser. This superheating effects a saving of about 30 per cent, due to the elimination of cylinder condensation. The absence of piping and the use of jackets produce a further saving of about 10 per cent, due to avoidance of radiation from cylinders and piping; the cylinders are jacketed with live steam in the dome and with waste gases in the stack, therefore the leakage of heat is not out of the cylinder but *into* it from the hotter surrounding mediums. For superheated steam this disposition has the advantage that, while in the ordinary saturated steam the re-evaporation during expansion of moisture must all come out of the heat in the steam and walls of the cylinder, in the German engine it comes out of the waste gases and the live steam around the cylinder. In the first case the condensation is further aggravated by the re-evaporation; in the second it is effectually turned into mechanical work on the piston, with no real loss of heat.

Whereas, in the ordinary small boiler plant, the stack temperature is anywhere from 500 to 600 deg. Fahr., depending upon the fireman and the steam pressure, in this type of superheated steam-engine the two superheaters and the cylinder extract heat and bring the stack temperature down to 380 deg. Fahr. Thus the stack loss is cut down to an equivalent of about 10 per cent of the total coal consumption, which is already small. Finally, there is the waste of feeding the boiler and the feedwater itself. The usual plan in the United States is to put a couple of small feedpumps somewhere in the engine-room, run piping to them from the steam main and keep them going slowly all the time or else run them once every half hour, allowing them to stand idle the rest of the time, with drains dripping water enough to keep the cylinders clear. Now, all this comes out of the coal pile. The pump does not throw less than 100 lb. of water per hp-hour, say 5000 lb. of water per hour, to feed a 100-kw plant, and if it stands idle it will drip about 25 lb. of water every ten minutes

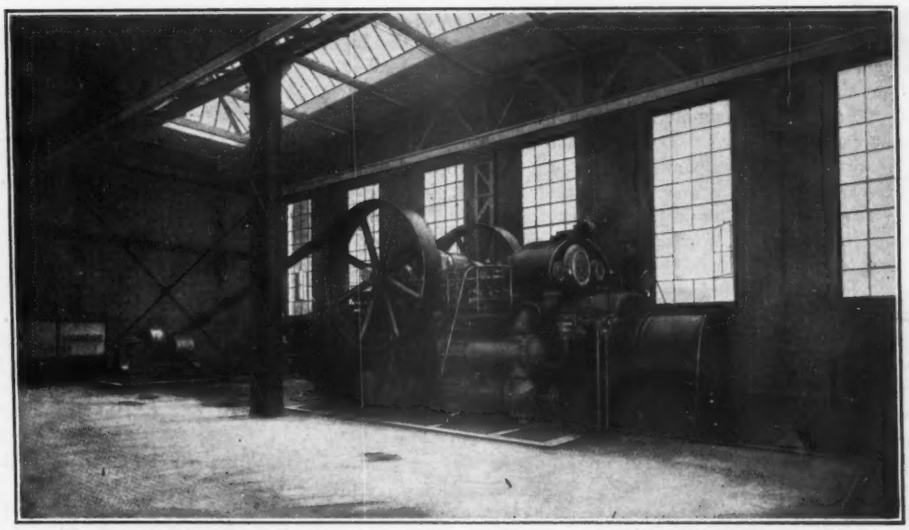


Fig. 2—350-H.P. Electric Light and Power Station at Salbke, Germany.

from its drains; that is, 500 lb. of water an hour, which is a very considerable loss in a small plant; the main engine only takes 3500 lb., therefore the pump wastes one-seventh of the coal pile, or 0.7 lbs. of coal per hp-hour. In the locomobile unit, as it is called, the boiler is fed by a feed pump driven directly from an eccentric on the crankshaft, so that the expense of boiler feed is merely the mechanical work done on the pump in terms of per cent of total coal consumption.

A further advantage obtainable in the use of superheated steam is that, at 600 deg. Fahr., it occupys 25 per cent more value per pound at any given pressure than saturated steam. It is difficult to show this up in comparative figures, but, assuming two plants of 100 hp, one making and using steam in accordance with ordinary practice and the other by the more advanced methods as exemplified in the locomobile, a comparison may be made which will roughly show what each does with the coal. The performance tests of the German superheated engines, as made time and again by various professors of technical institutes, have demonstrated an average coal consumption of 1.1 lb. per hp-hour, while the ordinary small plant in the United States when in good condition operates with 5 lb. per hp-hour, as is shown by the average coal bill of the small electric plant. The one will use 500 lb. of coal per hour and the other 110 lb. Taking the coal as good steam coal at 14,500 lb.-Fahrenheit units per lb., the ordinary steam plant uses 7,250,000 heat units, while the locomobile unit uses only 1,590,000 heat units. The simple steam engine using 35 lb. of steam at 80 lb. will use about 5,100,000 heat units in steam, and the superheat engine, at 170 lb. per sq. in., 170 deg. feedwater and 10 lb. of steam will use 1,360,000 units. This leaves in the one case 2,150,000 units lost up the stack and used for running the boiler feed pump, say 1,400,000 up the stack and 750,000 in the feed pump. In the other case, 230,000 units is lost up the stack and 2500 expended in boiler feeding. Of the known steam losses, in cylinder condensation the simple engine will lose about 30 per cent of the heat in the steam, 1,530,000 units, and the superheated engine 9 per cent or 130,000 units. The heat rejected into the exhaust will be in the one case 60 per cent to atmosphere, or 3,000,000 units; in the other 50 per cent rejected into the condenser, or 765,000. This accounts for all the losses in the use of the steam except boiler, steam piping and cylinder radiation. In both engines the total heat radiated will be about the same from the boiler as the somewhat better lagging of the locomobile is offset by the higher steam temperature. The boilers are of different absolute dimensions, however, as one must make three times the steam of the other. The simple steam-engine boiler has about 2 per cent radiation, say 120,000 b.t.u., and the other one-third of this, or 40,000. In combined steam pipe and cylinder radiation there will be a trifle under 2 per cent for the simple engine, say 100,000 b.t.u., while in the superheated engine with cylinders mounted in the waste gases or in the dome of the boiler, and steam piping run inside the smoke box of the apparatus there is no loss of this kind.

In both cases, the total output of useful energy, 254,000 heat units of mechanical work, is the same, as is also the friction loss, 15 per cent, or 36,000 units.

These figures account roughly for the total expenditure of heat units in getting 100 hp and show clearly the double action of cutting down steam losses reacting to cut down boiler losses, the whole resulting in an economy very many times better than usual practice affords. These locomobiles are built at present up to 600 hp and as small as 25 hp, and therefore they cover the range of the isolated electric station very completely.

Some of the details of construction which are of special interest are noted below: The cylinder difficulty is gotten around by casting it all in one piece with dome or smoke box; expansion is provided for by mounting the shaft-journal saddle and the cylinder and guides in two distinct castings riveted to the shell of the boiler and adjusting cylinder-clearance to come right at full temperature. Packing, pistons, rings and piston valves are designed especially to handle superheated steam; ordinary engine practice will not do. No brass or copper must be allowed in contact with the steam as they lose 40 per cent of their strength at such temperatures. The general design of the engine is of the "old-fashioned" open type, turning over at 200 r.p.m., with adjustable crosshead guides and oil cups all over the engine. The writer has come to prefer it in small engines up to 100 hp, there having been so much trouble with the modern high-speed totally-enclosed crank-oiled engines, which no one can get at to fix; they are always melting out boxes for failure of oil from one cause or another and develop knocks, no matter how often they are keyed up, due to skimpy bearing surfaces, high speed and general vibration.

In the boiler end, innovations quite as daring as in the engine have been made. To clean the boiler both ends are unbolted and the whole interior pulled out; corrugated furnace, tubes and superheaters in one piece—a vast improvement over requiring the firemen to crawl in through a manhole and scale tubes in crannies where he can hardly move the hammer. All this improvement required was to make the forward head smaller than the rear head and with an inside flange, also the courage to break away from the time-honored tradition of all the boiler joints being riveted. Clean heating surfaces assure good efficiency and long life, because joints and gusset-corners do not get clogged up with scale. Finally, both Wolf and other manufacturers have worked up a set of furnaces for these locomobiles that will handle low grades of fuel, such as lignites, peat, corn-husks, tanbark residues, shavings and shooks, bagasse, bark refuse, and lastly crude oil residues and crude oil itself.

MOTOR-GENERATORS FOR METER CALIBRATION.

There has been developed abroad and in this country a line of motor-generators especially adapted to the requirements of alternating-current meter calibration and testing. In all of these sets there are two generators, one to supply energy taken by the shunt coils and the other to furnish the energy used by the series coils. The former is called the potential or voltage generator and the latter the current generator. Both generators

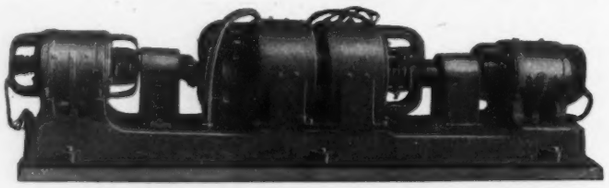


Fig. 1—Motor-Generator Set for Testing Meters.

may be wound on the same armature or separate machines may be mounted on the same base. The cost in each case is about the same.

By separating the sources of energy for the two coils of the meter it is possible to obtain any desired phase displacement of current and e.m.f. by a mechanical rotation of the field structure of one of the machines. This phase-shifting device is applied to the potential or voltage generator as it is the smaller machine of the two. The generators are especially designed for the purpose and give a sine wave e.m.f. They may be wound to give single-phase, two-phase or three-phase current, and in some cases double-current armatures are used, thus giving direct current as well as single or polyphase currents.

In Germany the manufacturers recommend that a direct-current, adjustable-speed motor be used to drive the set, as such an arrangement may be used for any commercial frequency. A set is built by the Oerlikon Company which has been used over a frequency range of from 20 cycles to 120 cycles per second. When alternating-current motors are used that company designs them to give a very slight slip, not over 2 per cent at maximum load. In most of these sets an exciter is mounted at one ex-

tremity of the shaft. The driving motor is mounted at one end so that it may be easily removed. In cases where the set is not in constant use the motor may be used for other purposes between times.

A set made by the General Electric Company for the New York Edison Company is illustrated herewith. This is installed in the meter department at Rider Avenue and 140th Street, New York, and is used for testing alternating-current meters used in the Bronx district by the New York Edison Company. The motor-generator set consists of a two-phase, 210-volt, 60-cycle synchronous driving motor coupled direct to the current generator rated at 200 amp and 25 volts. On either end of the shaft is a potential or voltage generator wound with two independent 110-volt windings so that 210 volts can be obtained across both. Both of the potential generators have movable field structures so as to give any desired phase relation, and while the field structure is at present moved by hand, it is the intention of the company to equip the field structures for automatic adjustment by means of small motors similar to the scheme at present employed in some types of induction regulators.

The main value of the set is the steadiness of the voltage and current obtainable. The indications on ordinary undamped instruments are very steady; in fact, comparable with the direct-current system of testing employed in the direct-current districts in which storage batteries are used. Currents as high as 350 amp and voltages ranging up to 300 volts are available and any desired power-factor. The flexibility of the system is apparent and the feature of steady supply makes it possible for one man to make the test with the same accuracy as would be obtained in direct-current practice with a storage battery as

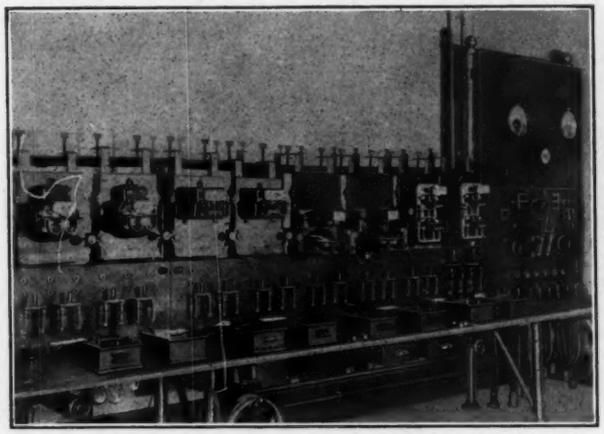


Fig. 2—Testing and Control Boards.

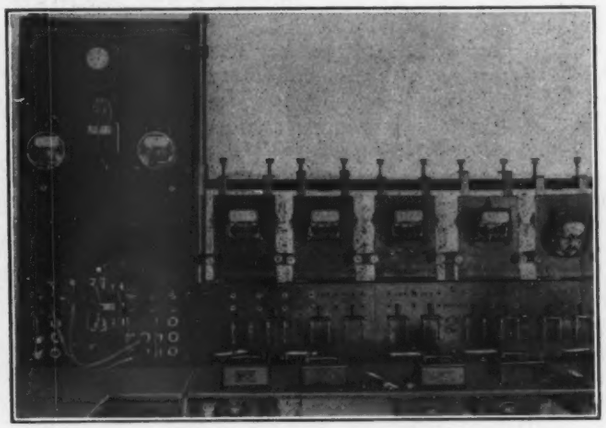


Fig. 3—Boards for Time Test and Calibration of Meters.

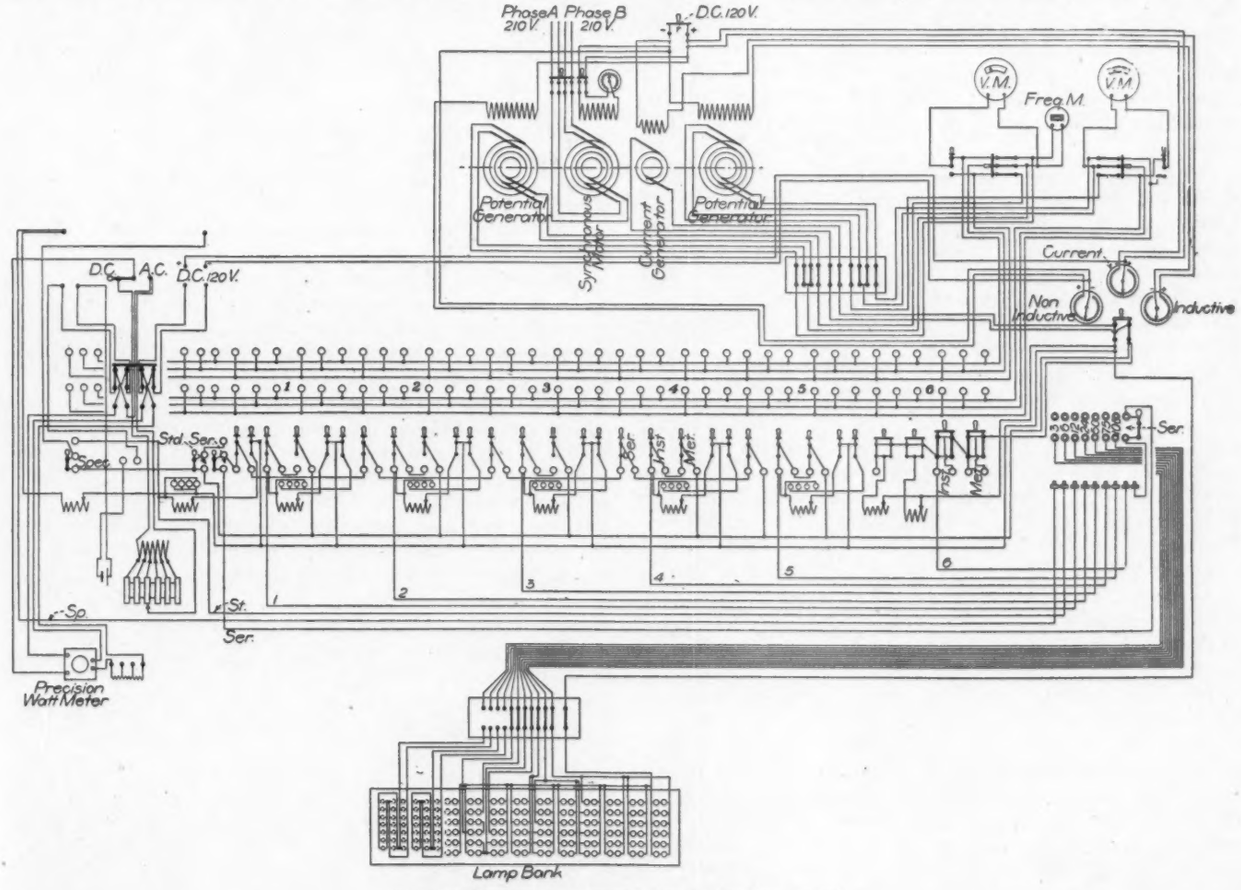


Fig. 4—Diagram of Connections of Testing Board.

the source of energy. Heretofore two men were required, one to take the standard wattmeter reading and the other to read the meter under test, so that the installation of the motor-generator set has greatly increased the testing facilities of the station.

Fig. 4 is a diagram of the testing connections. The employment of two potential generators permits the use of two potential buses on the board, one adjusted for unity power-factor and the other for any other desired power-factor. Tests can be made on meters, therefore, under inductive and non-inductive loads by merely transferring the testing plugs from one bus to the other. Current gradations are obtained by the use of a bank of carbon-filament series lamps used in connection with carbon rheostats. A Hartman-Braun frequency indicator and hot-wire voltmeters are employed on the switchboard, the company having these on hand. A Westinghouse precision wattmeter is used to check the testing standard and is itself maintained in calibration in position by an independent authority—the Electrical Testing Laboratories. Plugs are provided so that any desired load can be connected to any panel. By using jumpers any combination of loads can be obtained. One panel has extra heavy current connections for testing large meters. On the end of the testing board, near the window, a panel has been fitted for making time tests of meters and service tests of prepayment meters.

ELECTRIC SPOT WELDING.

By A. E. Buchenberg.

SPOT welding, now coming into prominence for a great variety of work, is widely different in method and application from ordinary butt welding. These two forms of electric welding have no features in common save the formation of the molecular union under mechanical pressure while the metal at the point of weld is in a heated semi-fluid condition.

In general, electrical butt welding is applicable to joining together the ends of bars, rods, forgings, etc. In this case the heating current through the ends of the work across the junction of the two pieces is approximately evenly distributed over the entire area of the abutting surfaces. When the entire stock has reached a welding temperature for a short distance on each side of the point of weld, the two pieces are forced together endwise to form the union.

Broadly speaking, spot welding is limited to the uniting of overlapped sheets with comparatively large surface areas of metal in contact. Only a small percentage of the actual contact surface is jointed, the welding area being confined to one or more distinct locations which are entirely independent of each other. The heating current does not flow across the entire area of the contact surface as in a butt weld, but is confined to a limited path at each of the so-called "spots." The heating action of the current is thus localized in a restricted area to form a weld, while the remainder of the stock remains cold. This concentration of the heating current may be accomplished in either one of two ways, both of which are taken up in detail below.

The first method, commonly known as "point welding," necessitates the raising of slight independent points or projections on either one or both of the surfaces to be spot welded. These points prevent the entire overlapped surfaces of the stock from coming together, and the contact between them is, of course, made on the projecting points. If current is now caused to flow across the two pieces of work by means of flat current-carrying dies or electrodes (one on each side), the current between them must obviously be concentrated to the contacting points or projections of the metal. These projections under the heating action of the current almost instantly reach a fusing temperature, and the weld is completed by mechanical pressure exerted upon the dies to force the flat surfaces of the stock together. The points or projections on the metal may be of any size or shape to obtain the proper conditions of assembling or mechanical strength for any particular piece of work. One or more spots may be welded at the same instant with one operation. The principal objection to this method is the necessity of preparing the stock under a punch or press for the welding operation, and the difficulty of assembling some classes of work with projections on the surface of the stock.

With the second method no preparation of the stock is required. The heating current is concentrated to the area of the spot to be welded by means of pointed dies or electrodes, one on each side of the work, whose opposed ends are shaped to the size of the spot weld required for any particular piece of work. The weld is completed as in the first method by means of mechanical pressure to force the dies together.

The necessary component parts of an electric spot-welding machine for either of the two methods are as follows:

First.—A transformer to reduce the line or primary voltage to the very low secondary voltage required for welding. The transformer secondary current, or, in other words, the heating current, is, of course, much greater than the line current through the primary coils of the transformer. Single-phase alternating current is required and any standard supply voltage can be used.

Second.—Two welding dies opposed to each other and attached, one to each terminal of the transformer secondary winding. In the first method these dies are flat copper plates, while in the second method they are usually in the form of short copper rods with rounded ends. The die-supporting mechanism is arranged to allow a limited motion of the dies toward and away from each other on an axial line through the center of the two die rods.

Third.—A powerful cam or toggle-compression mechanism operating through the die supports to exert mechanical pressure on the material inserted between the opposed faces or ends of the welding dies.

Fourth.—A switch to close and open the circuit through the primary coils of the transformer when making a weld. This switch may be located in any convenient position on the machine for hand operation, or it may be automatically operated by the compression mechanism to break the circuit at the instant the stock has reached a welding temperature.

The operation of the machine is as follows: The two parts to be spot welded are properly located by means of a jig between the opposed ends of the welding dies, which are normally separated to afford the proper clearance. The dies are now brought together by means of the compression handle to grip the stock between them. At this stage only enough pressure is exerted to bring the welding surfaces into contact. The switch is now closed and the stock begins to heat at the one spot directly between the opposed faces of the dies. When a welding temperature has been reached, the switch is opened and heavy pressure exerted by the compression lever to form the weld. The time required to make a spot weld is short, ranging from a fraction of one second on thin stock to three or four seconds on 0.25-in. stock. The time during which the current is used is so short that only a very small amount of heat is carried to the surrounding metal by conduction. On the thinner stock the discoloration from heat is barely noticeable beyond the area covered by the welding dies, while with heavier stock the discoloration may extend to a distance of 0.125 in. all around the weld.

The diameter of the spot welds will depend upon the size of the projections thrown up on the surface of the metal or upon the area of the welding die contact points, which in either case may be of any desired area. Since the ultimate strength of the weld will in most cases be determined by the tearing strength of the metal around the circumference of the "spot," the diameter need not be great. A diameter of 0.25 in. is amply large for No. 20 gage stock and 0.375 in. for 0.25-in. stock. The number of welds required for any particular piece of work will depend upon manufacturing conditions and strength requirements.

While the momentary current required to make a spot weld is considerable, the time is very short, and no current is used except when the switch is in the closed position to make a weld. These conditions and the fact that expert labor is not required make the actual energy consumption of the machine surprisingly small and the cost of operation low.

Where the stock has been previously prepared by punching up projections, as in the first method mentioned, flat welding dies of considerable area may be used. The heated plastic metal of the projections is brought back practically flush with the surfaces of the sheets under the pressure, and a smooth surface is left. In the case of comparatively heavy metal the depression left by the punch will be more prominent. The heat discoloration, as noted above, will, of course, always be present.

Spot welds made without preparation of the stock by the use of pointed or rounded dies will usually show a slight depression below the surface of the plate on both sides of the work. These depressions will conform to the shape of the ends of the dies and are caused by the pressure exerted while the stock is hot. They are always slight, being hardly noticeable on thin stock and reaching a maximum depth of 0.03 in. on 0.25-in. stock. The usual heat discoloration is present in this method, as with the first. If it is desired to obtain a perfectly smooth, unbroken surface on one side of the stock and avoid the inconvenience and expense of preparing the stock as in the first method, the pointed dies on this side of the work may be replaced by a flat die or plate of copper.

It is not necessary that the thickness of the two pieces to be spot welded be the same. As an example, No. 30 gage sheet can be welded to 0.25-in. stock. Tinned or galvanized stock, as well as aluminum-coated sheets, can be welded without difficulty. This statement holds true in welding the treated surfaces to each other or to black iron. The tin or zinc coating has a much lower fusing point than the iron body sheet and will be oxidized under the heat action and allow a welded union of the iron. The coating will, of course, be destroyed at the point of weld, leaving a black iron surface where the welding dies have been in contact with the material. Dissimilar metals, such as iron and brass, can be spot welded to each other in a very satisfactory manner. A variation of spot welding is the welding of the cross-wires of refrigerator and stove racks, wire fence, kitchen utensils, etc. The heating current is concentrated at the individual points in practically the same manner as mentioned above.

Spot welding, on account of its low cost and superiority over riveting in strength and the elimination of projecting rivet heads, is being applied to a wide variety of work, among which may be mentioned metal utensils, hardware specialties, metal furniture, automobile bodies, metal door and window casings, etc.

METHOD OF PRODUCING DUCTILE TANTALUM.

A patent granted May 17 to Johannes Schilling, of Berlin, and assigned to Siemens & Halske Aktiengesellschaft, describes a method for producing tantalum which is stated to excel any method previously known in simplicity, cheapness and high yield. As raw material tantalic acid is employed, which is the cheapest source of tantalum. The tantalic acid is reduced by means of hydrogen, a metal crucible filled with raw material being subjected in an electric furnace to a stream of oxygen. The metal crucible may be of nickel, either plain or coated with tantalum, or may be entirely of tantalum. The crucible is connected to one side of the circuit, the opposite electrode consisting of tantalum. The metal thus obtained is very brittle and contains much hydrogen. In order to secure a ductile metal, free from hydrogen, the product is submitted to another purifying process, consisting in keeping the metal in a molten condition for a long period by continuously drawing off the separated hydrogen by means of an air pump.

PROBLEMS IN POWER TRANSMISSION.

Mr. Harold W. Buck, in a paper presented at the St. Louis N. E. L. A. Convention, entitled "Present Problems in Power Transmission," outlined in an instructive manner many of the problems in the transmission of energy that have not yet been satisfactorily worked out.

The author remarked that the rise in the price of wood and the reduction in the cost of fabricated structural steel have naturally led to the substitution of steel towers for the old wooden poles on many lines. Such steel construction enables higher supports to be used and consequently longer spans with the resulting economies. Steel supports also eliminate the fire risk, which is one advantage. The question of depreciation in a steel tower, due to corrosion, even if galvanized, has, however, not yet been definitely determined, for most tower lines have been in service for only a few years. If the steel legs of the tower are installed directly in the ground it is questionable whether the life of this part of the tower will be any longer than that of a wooden pole. The strength of a tower with its legs in the ground is also uncertain, since the quality of the soil varies to a great extent. If the legs of the towers are concreted in the ground the tower is greatly strengthened and corrosion is practically eliminated, but the cost per tower installed is thereby in some cases as much as doubled. Unless, therefore, the amount of power used in transmission is very large, so that the cost per horse-power of the line is reduced, steel-tower construction is almost prohibitive in cost. In order to reduce this cost it is common practice to make the smaller members of the tower not more than 0.125 in. in thickness. The life of steel members of this small section, even if galvanized, has yet to be determined, although the results on wind-mill towers are encouraging.

The lengthening of the span on transmission lines has been an obvious result of the introduction of steel towers. It reduces the number of insulators and consequently the opportunity for breakdowns, and has other advantages, but the lengthening of the span has introduced certain difficulties. With the old-fashioned short-span construction common on wooden pole lines the question of sag and strength of conductor was of very little importance. Lines could be installed slack, using soft-drawn conductors, and the strains on insulators, and supports could be reduced to a minimum. Conductors on this account seldom broke. The sag was small in any case, and a foot or so more or less made very little difference. With long spans, however, there is a radical difference in requirements. In order to reduce the height of towers, since their cost increases almost as the square of the height, the conductor must be drawn up to the maximum possible tension. This has eliminated the use of soft-drawn metal for conductors and has necessitated the development of commercial hard-drawn copper and aluminum of very high elastic limit. The long span also requires the stringing of the wire with the greatest care with accurate observations as to temperature and tension.

The high-working stress in conductors necessary in modern long-span lines has introduced new mechanical problems in insulator, joint cross-arm designs. Furthermore, the conductor is stressed so near to its elastic limit at times of low temperature and high wind that a short-circuit on the line is almost certain to burn it enough to cause it to part from a reduction in cross-section. When a conductor does part under these conditions, the high initial mechanical tension is likely to cause considerable damage to adjacent insulators, cross-arms, etc., from recoil.

A further difficulty in the case of very long spans has resulted from vibration of the conductor and its crystallization and ultimate breakage at the point of attachment. In such cases it has been found necessary to make the attachment more or less flexible. The suspension type of insulator is specially favorable for this reason.

The economical span length for steel construction under present conditions ranges from about 300 ft. as a minimum to 750 ft.

maximum, depending upon a large variety of conditions peculiar to each line.

For electromotive forces up to about 60,000 volts the standard type of pin insulator construction gives very satisfactory results. With the rise in transmission voltage above this figure, however, mechanical difficulties are encountered due to the large size of pin insulator required. The cost of this type of insulator increases nearly as the cube of increase in voltage, above 60,000 volts, and the necessary height of the pin imposes on the cross-arm tensional strains, which are objectionable.

Probably the most important and radical improvement which has taken place in recent years in energy transmission has been the development and introduction as a commercial success of the so-called suspension insulator construction. It superseded the pin type almost immediately for the very high voltage lines and now is standard for voltages above about 80,000. Its advantages and its successful performance have been definitely established on a number of important transmission systems already in operation.

The suspension insulator requires a higher tower than does the equivalent pin insulator. This is a disadvantage, but it is offset by the simplification of the cross-arm possible with the suspension insulator and the elimination of torsion on the arms and head of the tower. The hardware used in connection with the suspension insulators of various forms is not altogether satisfactory, and there is a field for development and improvement here.

Where pin insulators are used the ordinary method of construction consists in drawing the conductor up to tension over the top of the crossarms or through the groove in the top of the insulator. Since each pin insulator is a fixed point on the line the conductor when up to tension can be tied in at any insulator and fixed until the next few spans are drawn up, and so on. With suspension insulators the method is not so simple. Usually the wire is slung in snatch-blocks, one hung from each cross-arm and a mile or so of conductors drawn up to tension. The cable is then fixed to some tower with an auxiliary clamp. After this operation it is necessary to transfer the cable from each snatch-block to the suspension clamp on each insulator, and ultimately the auxiliary clamp must be removed. The extra labor involved puts the suspension insulator at a disadvantage in cost of construction. There are possibilities for improvement here, especially in training linemen to this special work, which is new to most of them. Experience is specially necessary for the tying-in of conductors at dead-end insulators where the operation is quite complicated.

There has been considerable discussion as to the best method of securing conductors on suspension insulator lines. Probably the most satisfactory is to place at regular intervals along the line, one mile or so apart, extra strong towers where dead-end insulators can be installed and the line fixed at these points. These towers should be strong enough to withstand any strain likely to occur on the line. The intermediate towers should be equipped with suspension insulators, but with the conductor clamped thereto so that it can slip through in case of breakage. The intermediate towers need then be only just strong enough to carry the actual weight of the conductors and to resist the overturning moment, across the line, due to wind. At angles, dead-end insulators should, of course, be used with extra strong towers.

Italian engineers carried this principle to an extreme several years ago by using flexible towers as intermediate supports. The arrangement has special merit in connection with suspension insulators, and has recently been taken up actively in this country. It gives promise of economy, especially from the viewpoint of the cost of tower assembly and erection.

The success with suspension insulators on the recent 100,000-volt lines in this country has been remarkable, and such lines have actually given less insulator trouble than the early 20,000-volt lines when they were first installed. Since the degree of insulation with suspension insulators can be increased to almost any desired extent without involving prohibitive difficulties, there seems to be no reason in the insulator itself why much higher voltages should not give satisfactory results. There are, however, other considerations which will probably limit line e.m.f. to approximately 100,000 volts for some time to come. The insulation of the line itself is a much easier problem than that of transformers, lightning arresters and substation equipment, and these devices cannot be considered entirely satisfactory even at 100,000 volts in the present state of the art.

Oil switches become of enormous proportion at this voltage and involve the use of large quantities of oil under conditions where the fire risk is considerable. Furthermore, the spacing necessary between phases at 100,000 volts is so great that substation buildings are necessarily very large and expensive. It is questionable whether the economy in conductor cost in a voltage raise from 100,000 volts to 150,000 volts would not be more than offset by the increased cost of insulator towers, substations and operating equipment. There are other problems incident to the very high line voltages which have not yet been solved. The line-charging current is a serious element on long lines even at 100,000 volts, and the atmospheric discharge loss increases rapidly above this voltage. The spacing between conductors for the latter reason will have to be largely increased as the voltage goes up, and it will probably be necessary to increase artificially the diameter of conductor to reduce the discharge loss. This will increase the wind strains on towers and increase their cost.

It is probable that 110,000 volts is as high a voltage as is justified on a large commercial scale under the state of the art as it is at the moment. It would be well for electrical engineers to be conservative in this regard in the best interests of permanent advancement, since a too rapid rise in line voltage applied commercially is certain to result in unforeseen difficulties and unsatisfactory service which can only retard legitimate development.

Voltage regulation under the variable load on very long high voltage lines cannot be considered satisfactory under present conditions. This result is attributable principally to the great inductive drop and the excessive charging current, both of which are exaggerated at 60 cycles. For instance, the wattless leading current in a 100,000-volt, 60-cycle, single-circuit line 150 miles in length is approximately 50 amp, or equivalent to 8650 kva. This requires a very considerable generator equipment to operate the line even at no load. This charging current magnetizes the generator field so that the voltage will automatically build itself up until a condition of high saturation in the generators is reached. In order, therefore, to maintain normal voltage under these conditions the generator direct-current field excitation must be reduced almost to nothing. The combination is highly unstable. As the load comes on, if it is inductive, such as induction motors, the line-charging current may be neutralized or the resultant may actually be a lagging current. The generator fields must then be strengthened to a point which on the no-load saturation curve of the machines would correspond to a voltage much above normal. Assume then that some circuit-breaker on the system opens, thereby cutting off a large block of power load and also part of the compensating lagging current; the resultant current at the generators immediately changes from lag to lead, the line-charging current again predominating, and the generator voltage may rise as much as 50 per cent. This serious rise in voltage is caused by momentary speed rise due to reduction in load, armature reaction due to change from lag to lead, and in addition there is the boost of voltage over the line inductance due to the leading current. Other motor users on the system which remain connected to the lines under these conditions will suffer from the disturbance.

This problem in regulation can be solved only by the installation of shunt inductance placed at intervals along the line permanently connected thereto, and so adjusted as to neutralize the line-charging current regardless of conditions in the various receiver circuits. If it becomes necessary to neutralize the lagging currents of the receiver circuits, use should be made of rotary condensers. It is not feasible, however, to neutralize the lagging currents in the receiver circuits with the line-charging current if a good line regulation is required, since one is a constant and the other is a variable.

While a frequency of 60 cycles does not compare favorably

with one of 25 cycles for line conditions alone, on account of the increased charging current and inductive drop at the higher frequency, 60 cycles is coming into more general use on the large transmission systems. This result is due somewhat to the necessity of operating in conjunction with existing plants; but there is justification for it in the reduced cost and size of the transformers, which are large and expensive in any case at high voltages. One of the strong arguments formerly used in favor of 25 cycles for transmission is its benefit in rotary converter operation. On account of poor voltage regulation, however, it is no longer usual practice to install converters on long lines, since independent voltage control of the motor-generator set is required. Furthermore, the general adoption of 25 cycles for single-phase railway operation does not look as probable as it did a few years ago; so that greater advantages for overhead work seem to be in the 60-cycle system. Where extensive underground cable networks are involved a frequency of 25 cycles is desirable in order to reduce the cable eddy current and dielectric losses and to lessen the charging current.

Good progress has been made in lightning arresters through the development of the electrolytic type. If a disturbance takes place on a line, thereby causing a wave of high voltage, the electrolytic arrester allows the surge to pass through it satisfactorily and absorbs its energy. Under these conditions current from the generator does not follow and the arrester is not overheated. If, however, the actual voltage on the line rises for reasons previously discussed, the arrester breaks down and the current in the circuit is actually generator current at the higher voltage, and here the heat generated in the electrolyte is apt to cause an explosion with consequent ejection of liquid, oil, etc., and permanent damage to the disk units.

It is not likely that lightning itself will be as troublesome at 100,000 volts and over as it is on the lower voltages. The insulation of the entire transmission system is so high that the potentials due to lightning are not so likely to cause a puncture, and a point should ultimately be reached where all the apparatus will have sufficient insulation to be practically lightning-proof. Arresters are really of use more for protection from so-called surges than from lightning. Even these should be reduced as line voltages increase, since the reaction due to any sudden change in the line current is proportional to the square of the line current. The higher the voltage, of course, the less the current for a given power, so that the tendency should be to lessen disturbances.

The steel guard wire installed along the top of many recent transmission lines has given promising results, and the general opinion is that it is a benefit as a protection from lightning. It has an additional mechanical advantage in tying all the towers together and an added electrical use in connecting all the towers so that all must be at the same potential. If it is then necessary to work on a conductor on the line, this conductor can be grounded to any tower and brought thereby to the same potential with every tower, so that work can be safely carried on without danger from shock.

So long as overhead transmission lines exist as they are under the present state of the art, occasional interruptions to service will necessarily occur. It is better to recognize this fact and make provision to reduce the duration of interruption. An interruption once or twice a year, lasting a few minutes, will cause very little inconvenience, even to the most exacting public utility. The real problem in satisfactory service is to design switching arrangements and provide spare circuits and apparatus so that when trouble does occur it can be located rapidly, isolated and service resumed at once. Resumption of service should never wait upon repairs.

One of the most important elements in case of trouble is effective telephonic communication between the various parts of the transmission system. The practice lately has been to remove telephone wires entirely from transmission towers, so that they will not be subject to trouble from the high-tension conductors. This arrangement is especially necessary on the very high-voltage lines because of static induction. The latter is more difficult to eliminate satisfactorily than is magnetic induction, which can usually be overcome by transposition.

The largest field for future evolution in energy transmission is toward high-voltage direct current. Its advantages over alternating current from the standpoint of the line itself would be very great. The effective voltage would coincide with the maximum, and the insulator problem would be reduced by 30 per cent. The number of conductors would be reduced to at most two, and possibly one with grounded return would be satisfactory. Line charging current and self-induction would cease to exist and the question of power-factor would be eliminated. The whole problem of energy transmission would be vastly simplified and costs for construction would be reduced. Such a development would undoubtedly double the practicable transmission distance. The problem is not one in energy transmission, but one in electromagnetic machinery, and it would involve radical developments and probably some new discoveries. The complications now necessary for the generation and utilization of high-voltage direct current are such that its general adoption would not be commercially practicable.

PROTECTING AND REGULATING LIGHTING SYSTEMS.

In discussing the paper entitled "Some Developments in Modern Lighting Systems" presented by Mr. C. W. Stone before the American Institute of Electrical Engineers in New York on May 17. Mr. Paul M. Lincoln remarked that all designers of large alternating-current generators have encountered the problem of bracing the generator winding so as to withstand the tremendous mechanical shocks due to short-circuit or of reducing the shocks by introducing external reactance. The severity of short-circuit shocks increases both with increase of output rating and with increase of speed. The modern tendency is toward larger output ratings and higher speeds, and consequently the problem of bracing against mechanical shocks has come prominently before electrical engineers during the last few years. The first introduction of reactance coils to reduce the mechanical shocks was in connection with the Cos Cob generators of the New York, New Haven & Hartford Railroad.

In discussing the operation of feeder regulators, Mr. Lincoln said that rapidity of action has disadvantages as well as advantages. He claimed that feeder regulators, as designed up to date, have incorporated in their design no device to prevent hunting or overrunning. Increased speed makes for increased probability of the regulator over-running and not stopping at the proper point after it has started the voltage either up or down. There is a definite limit to which the speed of such a regulator can be increased without getting into trouble of this kind. This speed limit is easily within the range of either the induction type or the switch type.

There are two methods in common use of operating automatic regulators; one is to start and stop a motor so geared as to move the regulator, and the other is to throw in clutches upon a motor that is constantly operating. Either type of operating mechanism may be used with either type of regulator. The question of the inertia of moving parts of the regulator itself is apt to be greatly over-estimated in the case of the induction type of regulator. An investigation will show that the driving motor on the average regulator has an amount of stored energy that is from 100 to 1000 times that of the regulator itself.

Mr. Lincoln did not agree with the author in his conclusion that the switch type of regulator is the best on those circuits where the load is changing more or less rapidly. He stated that speed is a function of the driving mechanism, not of the regulator itself. He expressed the opinion that the switch type of regulator is a distinct step backward. For years engineers have recognized the great disadvantages of the switch or step-by-step type of regulator. The moving contacts inherent in the switch type have been entirely avoided in the induction type and it is this fact that gives the induction type its tremendous advantage.

ABSTRACTS OF N. E. L. A. CONVENTION PAPERS AND DISCUSSIONS

ABSTRACTS are given below of the papers, addresses and committee reports presented at the St. Louis convention of the National Electric Light Association. When a paper or report was discussed, a résumé of the remarks follows the abstract. The abstracts are grouped so far as possible by subjects, without regard to the order of presentation. The running report of the convention, printed elsewhere, presents the events in the order of their occurrence, and includes some subjects not taken account of in this section, such as social features and other occurrences aside from the presentation and discussion of formal papers and reports.

Association Affairs.

FOUNDING OF THE ASSOCIATION.

Mr. Elmer A. Sperry, of New York, in a paper entitled "The Founding of the Association in 1885," gave an interesting account of the founding of the National Electric Light Association, which occurred in Chicago in 1885. After several preliminary meetings at the Grand Pacific Hotel, a formal meeting was held there Feb. 3, 1885, at which committees were appointed to make arrangements for holding the first convention of the association, which occurred Feb. 25, 1885. Of those present at the meeting of Feb. 3 who are yet prominent in electrical engineering circles were Mr. Sperry, Mr. C. A. Brown, of Chicago, and Mr. F. S. Terry, now of New York. The first convention was called to order by Mr. George S. Bowen, of the Van Depoele Electric Manufacturing Company, and Mayor Harrison, of Chicago, delivered an address which, Mr. Sperry says, put all present in excellent spirits through the flash of its wit, and the appreciation displayed of the future of electricity. Mayor Harrison was followed by Dr. Elisha Gray, who dwelt on the future of electrical developments, and in conclusion said: "Twenty-five years hence, you will remember my words and mark the progress made in that time; I cannot tell you what it will be." The association started out with a membership of 71, and elected as its first president Mr. J. Frank Morrison, of Baltimore. Mr. Sperry said the meeting reflected the feeling of the time that the series-parallel distribution for incandescent lamps would prove superior to the multiple system, owing to the vast amount of copper required by the latter. The convention also reflected the controversy going on at the time between the telephone and arc-light people; the former then used the grounded circuit and endeavored to keep arc-light circuits at a distance from telephone lines. At this meeting the old fallacy of the electric motor not having an efficiency above 50 per cent was discussed. Mr. Sperry said that many could not understand how the efficiency could rise above 50 per cent, inasmuch as it was apparent that half of the total resistance was in the generator and half in the motor. In conclusion Mr. Sperry said that in a casual review of the proceedings of the first convention, one is impressed by the thought that pervading this first group of earnest men was a distinct feeling of things to come, and he added that at the present time we are on the threshhold of just as great advances in the coming quarter century of the history of the association.

REPORT OF COMMITTEE ON PUBLIC POLICY.

The committee on public policy, of which Mr. W. W. Freeman was chairman, submitted a report dealing with municipal ownership, uniform State legislation, natural resources, corporation tax, employers' liability, corporation prejudice, franchises, rates and public service commissions. Concerning conservation, the committee expressed the belief that there is danger of defeating the real interest in view if unwise restrictions are placed upon the development of certain resources when such development is essential to the prevention of economic waste. The opinion was expressed that the best possible means for conserving the fuel supply is through the development of waterpowers and that the necessary capital and engineering skill for this development cannot be attracted unless opportunity is given for a measure of profit exceeding that assured by ordinary commercial enterprises. In commenting upon employers' liability acts the committee said that many of the members of the electric lighting industry are already treating their employees, in respect to accidents, as liberally as will be required by any amended laws that are likely to be enacted. The opinion was expressed that member companies should favor the amending of liability laws so as to substitute for the present employers' liability a reasonable basis of employees' compensation for injuries. In regard to franchises, it was stated that the rates under short-term franchises must necessarily be higher than under franchises which promise permanence of investment. With the growing inclination to provide regulation of public service utilities there should be a decided reaction in franchise sentiment and in favor of perpetual or indeterminate franchises with adequate regulation.

REPORT OF MEMBERSHIP COMMITTEE.

The Membership Committee, Mr. H. H. Scott, chairman, reported the present membership of the association as follows: Class A (Company Members) 850; Class B (Company Employees) 3762; Class C (Professors) 10; Class D (Associate Members—Manufacturing Companies) 223; Class E (Employees of Class D) 688. The total of all members is thus 5533. The growth of the association is indicated by the following statement of membership from 1900 to 1910, inclusive: 140, 187, 338, 459, 495, 505, 562, 642, 680, 731, 850. The net gain of all members during the period from July 1, 1909 to May 23, 1910, was 2386. At present there are 28 Company Sections having a total membership of 2706. The grand total of membership of all descriptions is thus 8239, not including the membership of affiliated State associations. Measures are now under way to secure the affiliation of all State associations, and also to have such associations organized in the twelve States in which at present they do not exist. The committee recommends that aggressive methods should be adopted to form further geographical sections of the Association.

ADDRESS ON COMPANY SECTIONS.

At the Company Section meeting on Thursday afternoon, Mr. H. L. Doherty delivered an address, in opening which he said that the Company Sections will have to furnish to the national, state and geographical bodies the talent for future development in the association. It is impossible for every man connected with an electric light company to attend the Association Convention, and the Company Sections are particularly for the benefit of these. The Sections are composed of specialists in the different lines of work, and through it the members may acquire a general knowledge of the entire electric lighting business. He said that the constitution provides for national special conferences, the object of which is illustrated by assuming that sufficient interest has been worked up to call for a national conference on electric advertising. A publicity bureau would be organized and those using electricity for advertising would be invited. Mr. Doherty believed that this would bring more benefit to the central stations of the country than if they were to raise a fund of

$500,000 and employ it in individual advertising in the various cities. The matter of electrical advertising could by this means be given the greatest prominence at a cost not beyond the expense of central stations sending a delegate to be present at the conference. He believed that manufacturers would be glad to send lecturers to appear before Company Sections, not purely to advertise their goods but with an educational purpose also in view. He paid a tribute to Executive Secretary Martin who, he said, while engaged on a salary basis was prompted to take the work up entirely by altruistic reasons, and he considers the association is to be congratulated on having secured his services. Mr. Doherty in referring to the enormous expansion in the future of the electrical business, said that this will be due largely to the thorough organization of the industry, and that the most important element in thii plan of organization is the Company Section. Formerly companies organized their men in some kind of an association, but now this purpose can be much better served by the formation of Company N. E. L. A. Sections.

AMENDMENTS TO THE CONSTITUTION.

A number of amendments to the constitution were adopted relating to the assessment of dues and formation of geographic sections. Heretofore Class A, or company dues, have been assessed on a basis of "population served," which experience has shown to be an extremely difficult and uncertain term to apply in practice. The amendments now place the emphasis on gross income, for all such companies above a certain size; and below such size, the rate is arbitrary, based on population, as before. Entrance fees in this and all classes are abolished. It is believed that the new scale will bring in a larger income, and with the other income, enable the association to dispense with the annual convention fund, which reaches $10,000 to $12,000 annually, and is fully required for advance printing of papers, expenses of circularizing, arrangements, entertainment, etc. Another interesting change of the same character is the provision that Class D (manufacturing) companies shall hereafter pay $5 for each representative or guest. This is in line with the method in other large kindred associations, and is expected to cover approximately the sum now contributed by the group of associate members to the convention fund. The dues of holding companies are made $50 per annum. Other clauses relate to the method of forming geographic sections, and the rebate payment to them of the income to them, in a proportion not to exceed one-half. It is provided that no geographic section shall be less than one state or province.

Power House Design and Operation.

GAS-PRODUCER, GAS-ENGINE PLANTS.

In a paper entitled "The Adaptation of Gas Power for Central-Station Service," by Mr. Nisbet Latta, of the Allis-Chalmers Company, the gas-producer and gas-engine plant are put forward as a step in the direction toward the conservation of natural resources. As a specific case, Mr. Latta cited the great waste of energy in the Connellsville coke fields, where over 100,000 tons of coal are carbonized each day, with an equivalent waste of 50,000 tons of fuel daily. Each ton of coal carbonized is capable of producing 6000 cu. ft. of gas—that is, about 240 hp-hours. This gas might be utilized in gas engines to produce electric energy that would be distributed to the surrounding country. As another example of waste due to the inefficient use of coal, the district around Chicago is cited; 350,000 tons of coal are consumed every 24 hours in this district, and, according to the smoke inspector, the smoke in this city is estimated to damage merchandise to an extent of more than $50,000,000 a year. It also increases the lighting bill of Chicago more than $75,000 a day. All of these smoke nuisances could be practically eliminated by the use of gas producers. The methods used for smoke prevention in steam boilers are not economical of fuel, and usually involve considerable expense. Mr. Latta next took up the economies of the gas-engine equipment as compared with steam, and as a specific example compared a 1000-kw gas-producer gas-engine plant with a non-condensing compound steam-engine and boiler plant. These conclusions show a gross saving in operation of 20 per cent in favor of the gas engine. The life of the gas-engine plant is assumed to be the same as that of the steam-engine plant. The saving in operation naturally depends principally upon the cost of fuel and the load factor. For a 100 per cent load factor, the author shows that in this specific case gas and steam plants are about equal when coal costs $2 a ton; at 75 per cent load factor they are equal when coal costs a little less than $3 a ton, and at 50 per cent load factor equality occurs with coal at $5 per ton.

GAS-PRODUCER, GAS-ENGINE, CENTRAL-STATIONS.

The gas-engine committee, under the chairmanship of Mr. I. E. Moultrop, of the Boston Edison Company, confined its report this year principally to medium and small-sized installations which are using gas producers, or running on illuminating or natural gas. The results of inquiries made by it show that comparatively few installations use other fuel than producer gas. Illuminating gas, while well suited for gas-engine work, costs too much to be an economical fuel. The committee also collected statistics from a large number of isolated and industrial plants which are operated by gas engines. It was also stated that accurate data on the operating costs of gas-engine plants have been collected and are now in the hands of the executive committee, but not printed in the report. One of the most important developments during the year is the utilization of lignite fuels in gas producers. Heretofore this fuel has been unavailable for energy production, as it cannot be burned in boiler furnaces. Inquiries to the gas-engine manufacturers show that there has been no radical change in the design of gas engines during the year.

The statistics submitted in the report are compiled in four tables. Table 1 gives a list of producer plants of 50 hp and over in which the gas engine is not the product of the manufacturer of the producer. The items listed are: The producer manufacturing company, name and location of operating company, rating of gas engine, rating of the plant, use to which the energy is put, kind of gas used and kind of fuel used in the producer. Table 2 includes the same items, except that the gas-engine manufactures are listed and the data are given for stations of 50 hp and over in which the producer is not the product of the manufacturer of the gas engine. Table 3 covers the same ground as the foregoing tables, but both gas engine and producer are the product of the same manufacturer. Table 4 gives a list of plants installed by various manufacturing companies, giving the name and address of the operating company, rating of the plant, use to which the energy is put and the kind of fuel used.

DISCUSSION.

The two gas-engine papers were presented in succession and discussed together. Mr. Edwin D. Dreyfus stated that the first example in the United States of the generation of electrical energy from the waste gases of coke ovens is to be found near Lebanon, Pa., where the energy is transmitted for 10 miles. He thought the characteristics and possibilities of the low-pressure steam turbine had not been fairly presented by Mr. Latta.

Mr. H. W. Peck reported that observations in Rochester had showed that gas engines are more costly than central-station service when used under isolated-plant conditions.

Mr. C. Stone stated that the cost of maintenance of gas engines is much higher than stated by Mr. Latta.

Mr. Edward J. Conden related the experiences of the Harvard (Ill.) Light & Power Company with a 250-kw gas-producer plant. This plant cost $150 per horse-power instead of $75 per horse-power as the company was led to believe would be the cost. The cost of water alone for the plant amounts to $112 per month. He said that the depreciation was at least twice that of an equivalent steam plant.

STEAM HEATING FROM CENTRAL STATIO

Mr. R. D. DeWolf, of the Rochester (N. Y.) Railway & Light Company, presented a paper entitled "Decentralized Plants," in which he analyzed roughly the thermal losses and gave reasons why a central system can be made more profitable by distributing its generating plant in order to supply both electrical energy and steam heat. The author said that the central station has arrived at a point where it must offer steam heat if it will extend its business and compete with isolated plants, which are also steam-heating plants. A central-station plant, it was suggested, might consist of a large high-efficiency generating station equipped with condensing units, and a number of small non-condensing stations located in the industrial districts. The non-condensing stations have turbine units and the exhausts are all connected in parallel to a steam-heating main. The stations are all connected in parallel on the electric side and the load carried by the steam-heating stations is set by the demand for steam, the excess electrical load being carried by the high-efficiency station. When the demand for steam decreases one station may be shut down after another and the electric load shifted to the high-efficiency station.

There was no discussion of this paper.

CIRCULATING WATER INTAKES

A paper entitled "Water Intakes from the Mississippi River for Two Electric Generating Stations at St. Louis," presented by Mr. John Hunter, of the Union Electric Light & Power Company, St. Louis, described the construction of two intakes for condenser circulating water, which involved much boldness and originality of design. These intakes are from the Mississippi, which is a notoriously dirty stream, being at all times full of all manner of refuse and mud in suspension. In addition to this, the level of the river varies erratically through a range of about 40 ft. The first intake described by the author is located in the Ashley Street station and is embodied in the sea wall of the boiler-room. The openings into the well from the river are protected by racks and a screen having a 1-in. mesh. Two screens are so arranged that when one is hoisted to be cleaned the other is inserted in its place. The water is handled by centrifugal pumps and its velocity is kept at all points in the system of sufficient value to prevent the accumulation of mud.

The second intake is that of the Lewis Street station and is an engineering achievement of some magnitude, since the intake equipment represents an expenditure of about $80,000. Tunnels are run through rock under the bed of the river and suction pipes provided with small perforations driven through the rock into the soil at the bottom of the river. These suction pipes become clogged with dirt from time to time and means is provided to blow them out with compressed air. (Descriptions of these intakes are given in the article on the St. Louis stations in the issue of May 19.)

There was no discussion of this paper.

Apparatus, Electrical and Steam.

FOREIGN AND AMERICAN SWITCHBOARD PRACTICE

Mr. Stephen Q. Hayes, of the Westinghouse Electric & Manufacturing Company, presented a paper entitled "Comparison of European and American Switchboard Practice." Typical boards of European and American design were briefly described and compared as to method of construction, instruments, switches and arrangement. The author does not draw any conclusions, but leaves the reader to decide for himself which is better. European designs are characterized by minimum cost of material and maximum safety for operators, this being due to the low cost of labor and strict government regulations as to protection of workmen. In America the conditions are just the opposite, labor being very expensive, and, therefore, saving in material is sacrificed to saving in labor. Also, operating forces being limited to the lowest possible figure in America, the boards are built as compactly as possible so as to enable one operator to supervise a maximum amount of apparatus. The comparison between oil switches is particularly striking. In simplicity and compactness the American switches are striking when compared with switches of similar capacity of European design, which are shown in the paper.

There was no discussion of this paper.

STEAM TURBINE SPACE ECONOMY

In a paper entitled "Space Economy of the Steam Turbine," Mr. Paul M. Lincoln, of the Westinghouse Electric & Manufacturing Company, briefly reviewed the present status of the steam turbine in power-house design. The steam turbine, owing to the small space occupied and the large powers which are commercially practicable, is coming into more and more general use. There are a great many machines at present with ratings exceeding 10,000 kw, and Mr. Lincoln states that manufacturers would not hesitate an instant to undertake the building of a 25,000-kw machine. Reference is also made to the use of steam turbines operated at low pressure on exhaust steam. Various examples are cited; for instance, the Interborough Rapid Transit Company, where exhaust steam turbines have made the doubling of the station rating possible without addition of boiler capacity or buildings. Finally, the effect of steam turbines on station design is indicated, specific reference being made to the double-deck type of station, which is made possible by the relatively small amount of space occupied by the turbo-generator unit as compared with the boiler plant. The main points brought out are summarized by the author as follows: First, the space economy of the steam turbine over the equivalent engine-type unit is so marked as to be almost startling. Second, capacities are available in turbines that are out of the question in reciprocating engines. Third, in many existing steam plants designed for reciprocating engines, extensions of capacity with turbines is possible without additional expense for buildings, and the amount of possible extensions with turbines is some two to four times that possible with engines. Fourth, the turbine lends itself to complete plant designs that are impossible with engines, and the problem of plant ensemble using turbines is very different from that using engines.

There was no discussion of this paper.

DIRECT-CURRENT TURBO-GENERATORS

In a paper entitled "Direct-Current Turbo-Generators," Mr. W. L. Waters, of the Westinghouse Electric & Manufacturing Company, discussed some points in the design of high-speed, direct-current machinery. There are three ways in which direct current may be obtained from turbine-driven generators; namely, direct-connected, direct-current generator; unipolar generator; synchronous converter connected to an alternating-current generator direct-connected to a turbine. The direct-connected commutator machine is used for medium and small ratings; the unipolar machine has been used only in special cases, while in large machines direct currents are usually supplied through a synchronous converter.

The author points out that the two factors which limit the design of a direct-current turbo-generator are commutation and the collection of large currents at high speed. Commutation difficulties are overcome by the use of interpoles and in the most extreme cases by completely compensating the armature amp-turns with a distributed pole-face winding. The limitation of peripheral speed is fixed by type of brushes, and the revolutions are set by the turbine, the result being a long commutator of relatively small diameter. When the length exceeds 30 in. it is usual to divide the commutator into two of half length. According to present American practice the peripheral speed of the commutator is chosen between 4500 ft. and 6000 ft. per minute.

The question of brush material is a very vital one. The high conductivity of copper has led to the use of that material to a considerable extent in Europe, but the operating difficulties are so great with this type of brush that to it is charged the tardy introduction of direct-current turbo-generators in the United States. Various types of special brushes have been devised,

which will have high conductivity and yet good wearing qualities, but the author is of the opinion that the best practice is to use a good quality carbon on graphite brush and make the commutator large enough to work at the proper current density.

Some particulars are given regarding armature construction, such as the insulation and support of the coils. At present direct-current turbo-generators up to 500 kw may be considered as commercial; while larger sizes are built in Europe, the author believes that when more than 500 kw is needed that it is better to use an alternating-current turbo-generator with a synchronous converter.

There was no discussion of this paper.

Transmission.

PROBLEMS IN TRANSMISSION

An excellent paper by Mr. Harold W. Buck, of New York, entitled "Present Problems in Power Transmission" is printed on page 1449 in lengthy abstract.

DISCUSSION.

In connection with the presentation of this paper for the author, Mr. D. B. Rushmore outlined the conditions which led to the formation of the transmission section of the association, and explained the desirability of conducting the work involved under the auspices of the present association rather than forming a separate independent organization as was proposed about three years ago.

Mr. J. R. McKee remarked that on certain lines operating at 100,000 volts without lightning arresters no trouble has been occasioned by lightning, probably on account of the heavy corona loss at any excess above the normal working voltage.

HIGH-TENSION TRANSFORMERS.

Mr. Karl C. Randall, of the Westinghouse Electric & Manufacturing Company, presented a paper covering some points in construction and operation of high-tension transformers. The author described self-cooling transformers rated at 2000 kva which are now being built with special cooling tubes welded in place external to the case. He described also oil-filled transformers suitable to be shipped intact in sizes as large as 2000 kva. Much interesting information relating to the impedance characteristics of transformers was given, while a method of insuring the proper division of loads between transformers in parallel, involving the use of a reactance coil, was described.

There was no discussion of this paper.

PHENOMENA OF HIGH-TENSION LINES

In a paper entitled "High Potential Line Phenomena," Dr. Charles P. Steinmetz, of the General Electric Company, explained in simple language the elementary theory of the phenomena involved in high-tension line operation. Dr. Steinmetz first considers the dividing line between medium and high tension, and decides that high tension is reached when the capacity effects begin to be appreciable. Therefore, this limit cannot be set by voltage alone, but is also a function of the line itself. For instance, 10,000 volts is high tension in a cable system, whereas 30,000 volts is high tension in an overhead wire system. The author next takes up the energy relations in an electric circuit, showing the effects of inductance, capacity and resistance. The low-potential circuit, in which, according to Dr. Steinmetz's definition, capacity is negligible, involves energy lost in resistance and energy stored in a magnetic field. This type of circuit is compared to an induction motor, which speeds up upon receiving energy, and slows down when returning it; whereas the high tension circuit is likened to a synchronous motor, in which energy may be shifted back and forth between the mechanical energy in the rotor and the magnetic energy in the field, without any change in the total amount of energy received from or delivered to the outside. Having established these relations, Dr. Steinmetz takes up an elementary discussion of surging in transmission lines. By means of diagrams the action of surges is illustrated very clearly. The first case is that of a high-voltage charge, which may be due to lightning suddenly applied to an unloaded transmission circuit. The second case discusses and explains a surge due to the grounding of a loaded transmission circuit. Surges due to opening a loaded line and to closing a line with load connected are also treated in similar manner. Next, the effect of time on the striking distance of a given voltage is discussed. As an example, 35,000 volts applied for 0.005 sec. strikes through 1.33 in. of air; when applied 0.002 sec. the striking distance is reduced to 0.75 in., and when applied for 0.0005 sec. the striking distance is only 0.25 in., whereas if the same voltage is applied for a considerable time between needles the striking distance is 2 in. The reason given for this time effect is that energy is required to break down insulation. Finally, Dr. Steinmetz brings up the subject of corona, and shows by means of curves how the charging current and line loss are affected thereby.

There was no discussion of Dr. Steinmetz's paper.

LIGHTNING PROTECTION.

The report of the committee on protection from lightning, Mr. B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y., chairman, gives the result of over 500 replies received to circulars of inquiry. These replies indicate a higher degree of immunity from the effects of lightning than in previous years, which is ascribed as being in a large part due to the gradual improvements in methods of insulation and construction, more general use of arrester equipment and greater attention to the importance of proper ground connections. Meter failures appear to be proportionately less on large distribution systems with grounded secondaries. There were but few instances where lightning arresters themselves were damaged. The driven-pipe type of ground protection is being more frequently used. It is stated that transmission systems, especially those of extremely high voltage, seem to be particularly free from the serious troubles to which they were subject in former years, which is ascribed largely to the advances made in the construction and insulation of such systems. One of the large companies in the Middle West has arrived at the conclusion that line troubles decrease in exact proportion as the number of miles of overhead grounded wire increases. Among the recommendations of the committee are the following: That pipe grounds be used in preference to ground plates, and that for station protection a number of scattered grounds offer the best protection, which should be of the driven-pipe type. The most common method of using this ground is to drive one or more 10-ft. lengths of galvanized pipe into the ground, leaving approximately 6 in. exposed, to which portion the ground wire is soldered or secured by some form of mechanical joint. Grounds should be tested periodically, and a pipe ground should have a resistance from the ground wire to an adjacent water pipe of from 15 ohms to 30 ohms. Lightning arresters should in general be placed approximately 2000 ft. apart, but closer together at especially exposed points. They should be inspected at the beginning of the lightning season, and as soon after each storm as possible. Daily records should be kept of disturbances on the system, together with the loss of apparatus and interruptions that followed. Forms of blanks for this purpose are given in the report. General practice in station equipment of transmission systems shows the value of several different types of lightning arresters working in multiple. The most practicable method thus far found for protecting overhead lines from insulator failures, and other damage due to lightning, is that of shielding by means of grounded overhead wires. A single steel cable strung well above the center of the operating lines, and grounded at frequent intervals, has proved effective. Ground wires on either side of the line are probably an additional benefit, especially near stations. On tower lines the overhead wires should be grounded at every tower, and on pole lines at least every 200 ft. or 300 ft. Some form of lightning rod should be extended sev-

eral feet above the overhead ground wire at each of the points where it is grounded.

DISCUSSION.

Dr. C. P. Steinmetz presented facts showing that a choke coil serves merely as a barrier for high-frequency disturbances, and may act either as an aid or a hindrance in lighting protection according to its location with reference to the arrester and the point at which the disturbance originates. For best protection an arrester should be placed on both the station side and the line side of each choke coil.

Mr. W. N. Ryerson said that records should be kept of all lightning disturbances and their effects upon the arresters. For this purpose there is now being developed an automatic recorder for showing the time and result of the operation of any arrester in service.

Mr. C. F. Scott described the system of record keeping employed at Helena, Mont., where accurate knowledge is obtained of each disturbance, the results being interpreted according to the time, location and severity of the discharge.

Distribution.

FUSE TESTING

A paper by Mr. Alexander Maxwell, of the New York Edison Company, entitled "Use of the Oscillograph in Fuse Testing," had as its objects, first, to discuss certain conditions affecting the operation of enclosed fuses, especially under short-circuit conditions; second, to point out the value of the oscillograph in the investigation of these conditions; and third, to present the results of a number of tests made with the aid of the oscillograph. The author said that the quality of a fuse is determined by the reliability of its calibration, or rating, and by its performance when opening a circuit under overload conditions. The calibration is determined by the current which the fuse will carry continuously without undue heating and by the time required to open the circuit under various overload conditions. These characteristics are quite easily determined by simple tests and are not affected by the constants of the circuit in which the fuse is placed. The overload performance is the most important measure of the value of a fuse, and a short-circuit close to the terminals of a source of supply is, of course, the most severe overload condition.

The fuses tested were of the porcelain-covered type, being entirely sealed. All of the tests were made by short-circuiting the fuses directly on the circuits, the results of the tests being recorded by means of an oscillograph. The records showed that at the instant of closing the switch the current, which had previously been of zero value, increased at once to a certain maximum value when the circuit was interrupted and then decreased to zero. The curves of decreasing current was not similar to the curves of increasing current owing to the fact that the circuit is no longer one possessing simply a substantially constant resistance and inductance, but the decaying current is controlled largely by the rapidly increasing resistance of the cooling vapor path.

It was found that under different testing conditions the short-circuit current and the energy expended within the fuse varied widely. By integrating several of the records made from 100-amp fuses it has been found that the energy input varied from 1200 to 8000 watt-seconds. So far as these records show, there was no definite relation between the total energy input and the resistance of the circuit. There was, however, a rough relation between the maximum instantaneous power input and the resistance of the circuit. The time interval for the operation of the fuses also varied from 0.004 sec. to 0.095 sec., for the 100-amp fuses, without any apparent relation to the known constants of the circuits.

It was found that there is a definite effect when inductance is introduced into the circuit. In one case the maximum current for the inductive circuit was approximately 80 per cent of the current for the non-inductive circuit. The maximum power input for the non-inductive circuit was about 900,000 watts, and for the inductive circuit about 750,000 watts. However, the duration of the short-circuit was 0.0063 sec. on the non-inductive circuit, and from 0.0086 sec. to 0.0097 sec. on the inductive circuit. The tests indicated that the inductance of the testing circuits should be taken into account, as well as its resistance, or the regulation of the supply source.

The author remarked that the oscillograph affords valuable information of general interest relating to the disturbances introduced in circuits when short-circuits occur, and the magnitude of the short-circuit current, as well as the general operating characteristics of fuses when short-circuited. The oscillograph shows that when short-circuited, fuses may carry instantaneously from 20 to perhaps 100 times their normal rated current, and that, under these circumstances, they interrupt the current without disturbance.

There was no discussion of this paper.

FAULT LOCATION IN UNDERGROUND CABLES

The location of faults in cables designed to carry energy of high power, due to the comparatively low resistance of the conductors, is much more difficult than in telephone and telegraph cables. Mr. William A. Durgin set forth these difficulties in a paper entitled "Location of Faults in Underground High-Tension Power Cables," and described a method devised for use on the high-tension underground cable system of the Commomwealth Edison Company of Chicago. The method of procedure in making these tests is as follows: Analysis of original fault, reduction of fault resistance, approximate location by predictive tests and final location by exploration tests. The terminals of all cables in power stations and substations are provided with means for connecting the conductors of each cable to each other and to ground. For analysis of the original fault, a voltmeter in series with a source of direct current and a resistor are used to measure the insulating resistance of the various conductors to ground and to each other, and with this outfit a great deal of information can be obtained. Having thoroughly analyzed the fault, the next step is the reduction of its resistance by passing a considerable current through it and thus carbonizing the paper insulation. In this way the resistance can usually be reduced to 100 ohms or less. For the approximate location of faults the relation between resistance and length is utilized, a special slide-wire bridge designed to make the Murray and Varley loop test being used. Where an open fault is indicated which does not permit the use of the loop test, a capacity measurement is made and the relation between the capacity and length is utilized in the approximate location of the fault. Having determined the approximate location of the fault, a tester is sent out with a special exploring device, which was described by the author in the *Electrical World* of Nov. 25, 1909. Mr. Durgin claims that by the use of this system of testing from 80 to 95 per cent of all grounds will be correctly located, and thus a great saving of time effected as compared to the usual cut-and-try method.

DISCUSSION.

Mr. Farley Osgood remarked that the exploring-coil scheme described by Mr. Durgin has been used by the Public Service Corporation of New Jersey for some time and has proved quite satisfactory.

UNDERGROUND AND OVERHEAD DISTRIBUTION

In a paper entitled "Departures from Standard Practice in Distribution Methods," by Mr. S. B. Way, of the Union Light & Power Company, St. Louis, are described a number of interesting details in the construction and design of electric distribution systems in St. Louis. The monolithic conduit system, which was originated in St. Louis, is described, and results show that it has been fairly satisfactory. (Details of this conduit system will be found in the issue of May 19.) Among the advantages claimed by the author for this type of construction are: Low first cost; smooth, straight, well-drained ducts free from joints, blisters and sharp projections; great fire

resisting ability and adequate protection of working cables from each other. In connection with the cables, mention is made of a method of fireproofing, which is accomplished by wrapping the cable with a cheap rope or cord, and applying a coat of cement mortar. In operation it has been found that under fire conditions the lead sheath has entirely melted away, leaving the cement covering intact and therefore preserving the cable from interruption. The overhead lines also embody numerous departures from standard practice. All poles are provided with a ring of well-tamped concrete at the ground line, the top surface being raised above the ground and sloping away from the pole, so as to form a watershed. All fixtures on the cross-arms, such as insulator pins, braces, guys, etc., are fastened by means of clamps, which practice has the following advantages: It avoids weakening of the arm by boring holes, affords less chance for moisture to collect, binds the fibers together, thus tending to prevent cracking, splitting, etc., and it also affords a more substantial support for the fixtures. All primary fuses, switches and meter boxes are mounted on standard line insulators, and carried by special brackets hooked over the cross-arm. The author also describes various appliances and fixtures which have been specially designed for use on these lines.

DISCUSSION.

Mr. H. W. Peck called attention to the undesirability of depending upon trolley wires or similar circuits to supply energy to a motor for drawing in cables when use can be made of the energy from storage batteries by employing an electric truck for haulage.

Mr. Farley Osgood expressed the opinion that unless extra precautions are taken in construction a smooth interior will not be obtained with the concrete ducts. He claimed that the mounting of pole switches, fuses, etc., on insulators involves an expense that is not justified by the advantages gained.

Mr. D. W. Roper remarked that where sandy soils are encountered it will be necessary to resort to wooden forms when pouring the material for the solid concrete duct structure. Concrete is advantageous in resisting fire and retarding the transfer of heat from the outside, but it is, therefore, disadvantageous in being a poor conductor for the heat unavoidably generated in the circuits laid in the ducts.

PRESERVING TREATMENT OF POLES AND CROSSARMS.

A report on the preservative treatment of poles and cross-arms submitted by a committee, of which Mr. W. H. Vanderpoel, of the New Jersey Public Service Corporation, is chairman, contains a great deal of valuable information and statistics obtained from direct correspondence and from government and other authoritative reports. At present it is estimated that there are required for pole renewals between 500,000 and 600,000 poles per year, and that during the next 10 years this number will be increased to in the neighborhood of 900,000 or 1,000,000. As a result of direct inquiry to a large number of transmission companies, the life of various timbers when used for transmission poles was given as follows: Cedar, 13½ years; chestnut, 12 years; cypress, 9 years; pine, 6½ years, and juniper, 8½ years. The inquiry circular issued by the committee contains 60 questions pertaining to methods of handling poles and cross-arms. Replies were received from 165 member companies, and were considered as representative of general conditions, the geographical distribution covering the entire United States quite uniformly. The committee recommends strongly that the companies should keep accurate and complete records of poles and cross-arms, and collect authentic statistics and literature pertaining to wood preservation. It also recommends the seasoning and in most cases preservative treatment of wood. It is claimed that a well-seasoned untreated pole will last at least 30 per cent longer than an untreated green pole. Directions are given for seasoning, and illustrations show clearly how the poles should be piled. The theory and various methods of wood preservation are described in considerable detail. No particular process is recommended for all conditions, although experience seems to indicate that coal-tar creosote gives the best results as a preservative, and that the high-pressure process of applying creosote is more flexible. Wherever the company is able to bear the expense of erecting a plant, the high-pressure process is preferable to the low-pressure or open tank process. The report is concluded with six appendices, which treat different phases of the pole question. In one appendix a method is given for comparing the costs of operating a pole line with treated and untreated poles. Other appendices contain information taken from the reports of the United States Government Forest Service, and a very interesting compilation is that taken from the report of the telegraph department of the German Government, which covers a number of processes of wood preservation and observations extending through a period of 50 years.

DISCUSSION.

Mr. Farley Osgood remarked that the investigations and recommendations recorded in the report will prove of great value to the overhead line construction committee which, during the next year, can make excellent use of the information placed at its disposal. He claimed that the introduction of a proper preservative method would result in a saving of at least $1,000,000 per year to the central-station companies. For application as a preservative use can possibly be made of some by-product of the gas companies which can be obtained at little cost. Whatever may be the result of the committee's work the report cannot fail to be of benefit to operating men.

Dr. H. Von Schrenk, chairman of the committee on timber preservation of the Maintenance-of-Way Association, related instances to show that many of the so-called preservative treatments are of no value, although several have considerable merit. There is an urgent need for technically trained men in the wood-preserving industry to investigate the various possibilities and limitations in the numerous methods now being advocated or to be developed subsequently. He called attention to the essential difference between European and American practices and stated that the former is usually not applicable under the conditions prevailing in this country. On account of the fact that the Maintenance-of-Way Association has prepared certain wood-preserving specifications as a result of extended investigations, it would be well for the National Electric Light Association to consider the adoption of these specifications with such modifications as may be found to be necessary.

In reply to questions by Messrs. W. E. McCullough, F. R. Cutcheon, R. J. Irvine and Leonard Fitzgerald, Mr. Vanderpoel stated that none of the patented processes had been specifically referred to in the report because it had not been possible to obtain definite information concerning all of the processes now being used. No brush or dipping application can be considered satisfactory for preservative purposes. Water-gas tar was not investigated by the committee, but probably will be considered during the next year.

VOLTAGE CONTROL

A paper entitled, "The Voltage Control of Generators and Feeder Systems" was presented by Mr. F. W. Shackelford, of the General Electric Company. The voltage control of a system is divided into two parts, the control of the generators and the control of the feeders. According to the author, the only thoroughly satisfactory method of generator control in use to-day is that employing the Tirrill regulator, and a short description is given of the method of operation of this device. In taking up the subject of feeder control, the author points out the extreme importance of good voltage regulation on lighting circuits. Curves are given showing the effect of excess voltage on the life of lamps, and of low voltage on the candle-power and power consumption. He also gives tables showing the cost of excess renewals due to excess voltage for systems of various sizes, ranging between 10,000 and 1,000,000 lamps. The types of regulators recommended for use on feeders are the induction type and the variable ratio transformer, equipped with collector rings for changing the ratio in a step-by-step manner.

DISCUSSION.

Mr. P. M. Lincoln remarked that in determining the effect of voltage changes on lamp renewals and energy charges, it is improper to assume that when the voltage is too high only

the lamp renewals are affected, while when it is too low only the revenue is affected. He stated that the speed of operation of a regulator depends less upon the type of the regulator than upon the auxiliary apparatus needed for its operation.

Dr. C. P. Steinmetz said that while it is customary to regulate simultaneously the voltages of two alternators operating in parallel, it is entirely possible to regulate each machine independently by means of an equipment of the Tirrill type.

POTENTIAL REGULATOR

Mr. E. E. Lehr, of the Westinghouse Electric & Manufacturing Company, in a paper entitled "Modern Single-Phase Potential Regulators," gave the results of some investigations and tests made with this class of apparatus. It is stated that the magnetizing current and inductance of modern regulators have been reduced to the lowest possible values by the use of distributed windings and partially closed slots for the short-circuited winding. The coefficient of self-induction of a winding is very materially reduced by increasing the number of slots in which the winding is placed. The series winding in a certain type is made in six separate coils, whereas in some of the older regulators use was made of only two coils. The primary or rotor winding is divided into four coils. The use of many slots gives a more uniform change of voltage with change of position than is obtainable with a few slots. The sub-division of the winding is also very beneficial from an insulating standpoint, as it keeps down the voltage per coil and between layers of windings. The method of winding the rotor is worthy of notice. The coils are machine wound and so shaped that they can be pushed through the slots into place without the least liability of becoming sprung or bent in the process. The primary coils necessarily have a large number of turns, and when they are bent or pulled into place more or less injury to the insulation is sure to occur. The coils are held in place by means of fiber wedges, and, therefore, can be removed and replaced more easily if damaged from any cause than if they were held in place by bands. The partially closed slots for the short-circuit coils, in addition to reducing the magnetizing current, also tend to decrease the torque required to turn the regulator shaft. This result is of considerable importance when automatic control is desired. The torque due to the currents in the windings is not very great in a single-phase regulator, but with a few open slots considerably more torque may be required due to a magnetic locking action between the teeth of the stator and rotor. This effect is almost entirely eliminated by the use of the partially closed slots.

DISCUSSION.

Mr. P. M. Lincoln called attention to the fact that the kinetic energy of the driving motor of an induction regulator is 1000 times as great as that of the rotor of the regulator, and hence the inertia of the rotor is negligible in comparison with that of the operating motor, and has no effect upon the rapidity of adjustment of the voltage.

GROUNDING SECONDARIES.

The report of the committee on grounding secondaries, Mr. W. H. Blood, Jr., chairman, gives the results of a canvass of central-station companies on the subject of grounding the secondary. Replies were received from 285 companies, of which 150 companies report that they do not ground secondaries at all. Of the 135 companies which do ground the secondary, 96 confine their grounding to the two-wire, 110-volt circuits or three-wire, 220-volt circuits, in which latter case the neutral wire is grounded. Twenty-six companies ground 220-volt circuits, and eight companies ground circuits where the voltage exceeds 300 between the line and ground. Forty out of 58 companies with polyphase circuits report that they ground at the neutral point. A few ground one leg on delta-connected circuits, so that the potential between line and ground is in some cases 220 volts or 440 volts. Of 190 companies reporting no fires, 98 ground their secondaries and 92 do not.

The majority of the companies which ground secondary circuits consider that the menace due to the breakdown of transformers and to crosses between secondaries and high potential lines is greater than the constant menace of a possible shock of 250 volts to 300 volts on grounded secondaries. As to the limiting voltage for grounding, the majority of those answering the circular letter sent out by the committee seemed to favor setting the limit between 220 and 300 volts. The committee discussed at some length its previous action in recommending that the grounding of circuits above 150 volts should be prohibited; and while still adhering to its original opinions on the subject, it believes that, in view of the differences of opinion of competent engineers, and because of the variations in established practice, it is wise to leave the responsibility with the individual companies themselves, and to let them decide as to whether they shall ground the circuits which carry secondary voltages in excess of 150. The committee strongly favors the grounding of all secondary circuits under 150 volts, as thereby the danger of handling faulty lamp sockets, frayed lamp cords, imperfect heating devices, bad fan motors and like apparatus would be almost entirely eliminated.

The committee states that the best method of grounding is by connecting to an underground water-piping system. The resistance of the ground plate as ordinarily installed is not permanent, and while low on one occasion may be several times higher at a different season of the year. When a sufficient number of pipes are used, and driven deep enough, this method is the most dependable one, and a better method than the ground plate as it is frequently installed. Referring to a previous recommendation of the committee that only those grounds are of sufficiently low resistance which cause a 2-amp fuse to blow at 150 volts, it is stated that for transformers above 20 kw on 2000-volt circuits the tests should be made with larger fuses, such as 3 amp for 30-kw and 4 amp for 40-kw transformers. A rough rule is that the carrying capacity in amperes of the fuse to be blown should not be less, for 2000-volt circuits, than one-tenth of the kilowatt capacity of the transformer to be protected. On 4000-volt circuits the fuse used would, of course, only have one-half of the above-mentioned capacity. Compliance with the above requirements would prevent the secondary wires from becoming charged with high potential current through the breaking down of the insulation of the transformer coils. The secondary wires, however, could still be charged with high potential current if the low-tension and high-tension wires became crossed and a ground already existed on the high-voltage lines. In such cases the high-tension station fuse would be the only one affected, and the resistance of the ground connection would have to be sufficiently low to cause the blowing of these fuses. Where single-phase circuits operated on 2000 volts are protected by 200-amp fuses, the resistance of the ground should not exceed 5 ohms. On 2000-volt circuits, where the station fuses are 100 amp or less, the ground resistance should not exceed 10 ohms. To afford ample protection, the ground resistance in all cases should be kept as low as possible, as the permanency of ground connections obtained by plates and driven pipes is particularly liable to change with weather conditions owing to difference in moisture; and for this reason, more than one plate or pipe should be used, so that the safe limits of resistance which have already been mentioned may not be exceeded.

DISCUSSION.

Mr. Farley Osgood discussed in detail why, when, where and how to ground secondaries. He said that both the danger to life and the fire hazard are reduced by grounding. Beyond doubt all circuits operating at e.m.fs. not exceeding 150 volts should be grounded, and it is extremely probable that when the e.m.f. does not exceed 300 volts grounding should be employed. Ground connections should be made at the premises of each customer, preferably to an active water-supply system.

Mr. C. W. Stone said that use should be made of multiple pipe ground connections covered with salt for insuring permanent conductivity.

DIRECT-CURRENT THREE-WIRE SYSTEMS

The advantages and disadvantages of various three-wire systems are discussed in a paper on "Methods of Deriving the

Neutral for Direct-Current Three-Wire Systems," by Mr. James R. Werth, Jr., of the General Electric Company. The systems compared are the three-wire generator; the two-wire generator with motor generator balancer set; two generators in series; synchronous converter with step-down transformers. Each system is taken up in detail and its advantages and disadvantages discussed. The conclusions are summarized in a table, which gives the weight, efficiency, floor space, cost, etc. The selection of three-wire apparatus is said to be governed by the amount of unbalanced current to be handled, and the necessity for shifting the neutral to be handled for inequalities in the resistance drop between the two sides of the system. Where unbalancing is excessive, two generators in series offer the best solution, and where unbalancing is small the use of a high-voltage generator, with suitable means of controlling the neutral, is advised.

DISCUSSION.

Mr. C. W. Stone called attention to the fact that the neutral point can be obtained, not only by means of the diametrical and star connections, but also by the double-tee connection. A three-wire generator does not provide exact division of voltage under unbalanced loads, and where voltage regulation is of importance it is best to use a balancer set.

In reply to a question by Mr. R. D. Donaldson, Mr. Werth said that switches are frequently placed in the neutral lead of a three-wire generator so that the circuit may be opened when a balancer set is used on the system.

OVERHEAD LINE CONSTRUCTION

The Committee on Overhead Line Construction, Mr. Farley Osgood, New Jersey Public Service Corporation, chairman, in its report, stated that as the specifications presented by the committee last year have come into considerable use, the committee has decided to leave it unchanged until its present program is completed, which will be two years hence. The present report deals with the methods of construction of secondary lines; that of next year will be devoted to high-tension work and the fourth year will be spent in reorganizing the entire work, thrashing out criticisms and putting the matter into final and complete form for use as a standard specification.

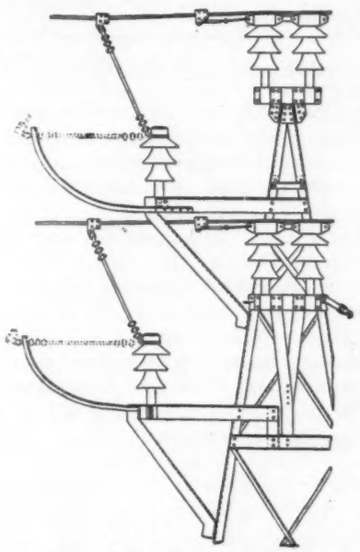
The present report divides the secondary distribution system up as follows: Poles and pole setting; stringing of wires; installation of transformers, fuse blocks, etc., upon poles; lightning arresters; consumers' service; joint use of poles, and railroad crossings. The subject of line construction is covered by a series of recommendations based on a study of the best practice in this country and is well illustrated. The complete text of an agreement for the joint use of pole lines by a telephone company and a lighting company is given. A special section of the report is devoted to line crossings, which was prepared in conjunction with the Committee on Electricity of the American Railway Engineering and Maintenance of Way Association. Wm. R. D. Combs is chairman of the latter committee and a member of the present committee. In this section the accidents which may occur due to failure of a line at the point of crossing are classified and briefly discussed, followed by a complete classification of all possible causes of failure. The specifications proper begin with a discussion of stresses and loading of conductor spans. Based upon a study of the United States Weather Bureau reports, the statement is made that maximum wind velocities occur in the cold months when sleet may be on the wires and that 80 miles per hour indicated velocity will be rarely exceeded, while velocities between 65 and 75 miles per hour may be expected several times per year. In calculations it is recommended that the thickness of deposited ice be taken as 0.5 in. independent of the diameter of the wire.

Cradles are not recommended except in special cases. It is better to use the money required for cradle construction in the improvement of the line structure itself. Metal poles and arms should be grounded by a conductor of size corresponding to the power of the line. Small conductors should not be used in crossing spans, since surface injuries affect their strength to a comparatively great degree. For the same reason stranded wire is better than solid. Double galvanized iron pins extending well up into the insulator are recommended as supports. Tie wires are not satisfactory for work of this kind, special clamps being better suited to the work. A clamp of this kind, designed for use on the New York Central lines, is shown in the illustration.

The sections on railway crossings has three appendices. One gives the strength and specific loading in pounds per foot corresponding to different sizes of conductor, for no ice, 0.5 in. ice and 0.75 in. ice and for different wind velocities. There is one table each for steel, copper and aluminum. The second appendix gives formulas to be used in the study of stresses in catenary spans and the third shows examples of pole top construction, one of which is shown in the accompanying illustration.

DISCUSSION.

This report was presented by the chairman of the committee, Mr. Farley Osgood, who stated that the material collected by the committee would later be incorporated in a book relating to line construction. The book will cover primary, secondary and high-tension systems. The report of 1909 dealt



Example of Pole Top Construction.

with primary systems; the present report is devoted to secondary distributing circuits, while the report of next year will relate to high-tension systems.

Mr. H. B. Gear outlined the conditions in Chicago, where the overhead lines are run along the alleys and use is made of the side-arm construction as standard for distributing circuits. He remarked that it is often not advantageous to operate transformers with their secondary circuits in parallel. In Chicago use is generally made of a single transformer per block, which covers a street length of 600 ft. Unless the load in one block exceeds 50 kw, which is the rating of the largest lighting transformer in use, transformers are not run in parallel on the secondary side. There are no interconnections between the secondary circuits along separate blocks.

Mr. Warren Partridge claimed that the erection of secondary circuits is usually not given the proper attention by central-station managers, who usually leave work of this nature to any chance wireman whom they may employ. For the purpose of minimizing the number of transformers to be placed on a single pole it is preferable to use single-phase rather than polyphase motors and thus make use of one transformer instead of two or three. In order to insure the best circuit connections the transformer should be placed as near the line wires as possible. In making connections to earth it is best to join the ground lead to water pipes, and where that is not possible to drive pipes into the soil for the ground connection.

Mr. S. B. Way remarked that it is desirable to mount all

primary fuses, switches and meter boxes on standard line insulators carried on brackets which are hooked over the cross-arm. It is well to place a fuse in series with each lightning arrester on the ground side.

Mr. S. J. Lisberger stated that the use of copper-clad steel wire enables one to erect much longer spans than when copper wire of the same conductance is used and hence has an important bearing on the cost of overhead line construction.

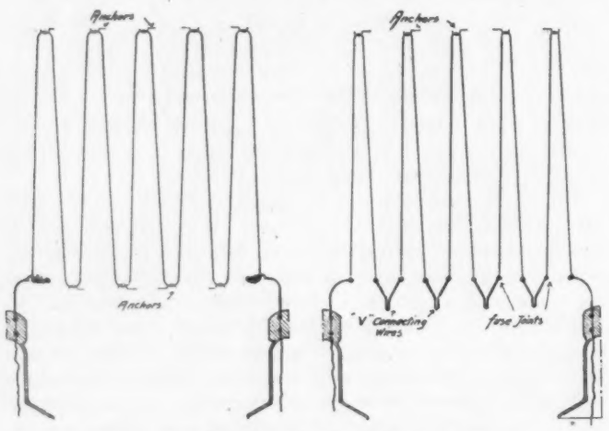
Mr. W. C. L. Eglin said that where the load is very large circuit-breakers should be used rather than fuses for protecting the lines against overloads. Upon motion of Mr. Eglin it was decided to issue in preliminary form a book on line construction to be submitted to the member companies for criticism and additions so that the final book will contain the best obtainable information on the subject.

Mr. Osgood, in closing, entered a plea for uniform methods of construction to be used by the central-station companies throughout the country.

Lamps and Illumination.

NEW FORM OF TUNGSTEN LAMP.

In a paper entitled "A New Form of Tungsten Lamp," Mr. Charles F. Scott, of the Westinghouse Electric & Manufacturing Company, describes a tungsten lamp called the "wire type" which has been developed by the engineers of the Westinghouse Lamp Company. The accompanying illustrations compare the wire type with the usual type of tungsten lamp. The main elements of the former are a single long filament, intermediate hook supports which hold the filament loosely and a terminal which is described as mechanically and electrically adequate. The common tungsten lamp consists of a number of filaments in series, the individual filaments having their ends fused together to stiff supporting wires. The new lamp adopts what is described as the ideal way of overcoming the disadvantages of this method, namely, by employing a single filament and so



Filaments of New and Old Tungsten Lamps.

mounting it that the filament is not rigidly fastened to supports. The single filament is wound back and forth around hook supports at numerous points, and a few turns near each end wound in the form of a spiral spring around the respective leading-in wires, and the ends fused. The several turns of the filament around the leading-in wires act as a sort of a spring, so that a slight bending of the filament, resulting from a blow or vibration, does not act directly upon the fused joint, as would be the case if the straight part of the filament came directly from the fused joint as in ordinary construction. Furthermore, carelessness in the act of fusing is stated to be of minor consequence in the wire type of lamp, whereas it might seriously lessen the strength of the filament in the common forms of lamp.

A tungsten lamp, using, say, five filaments, is analogous to five independent lamps in series, and its life will be fixed by that of the weakest filament. On the other hand, a process in which a yard or more of filament is made in one piece is not liable to the conditions which are possible and probable when a lamp contains several filaments which have been made at different times, and under the necessarily different conditions incident to commercial manufacture. It is stated that the mechanical excellence of the new lamp is attested by the result of comparative experiments with such lamps and lamps of the ordinary type. Among these was a test consisting in dropping a weight on a popular board held on supports about 4 ft. apart, to which lamp sockets were attached. It was found that with the wire type the weight had to fall from four times the height to cause the same destruction as of the fused type of lamp. The mechanical tests in the aggregate showed that the wire type of lamp is much less liable to injury than the fuse type where subjected to blows which are of a kind similar to those that may be expected in service. It is stated that the wire-type tungsten filament is made in long lengths, the present equipment making several miles a day.

DISCUSSION.

The discussion on Mr. Scott's paper was limited to the reply by the author to questions by Messrs. Osgood, Callahan, Prince and Ferguson as to the life, minimum rating and cost of the new tungsten wire lamp. Mr. Scott remarked that figures giving merely the life of certain lamps are apt to be misleading on account of the fact that the life depends to a very large extent upon the specific consumption at which the filament is operated. Observation would seem to indicate that the life of the wire lamp will be even greater than that of the present tungsten lamp by reason of the better mechanical arrangement of the filament. Although 18-watt lamps have been built, it is probable that the lowest standard rating will be 25 watts. These new lamps will be placed on the market at the same price as the present tungsten lamps.

DECORATIVE STREET LIGHTING.

Mr. E. L. Elliott, of New York, in a paper entitled "Decorative Street Lighting," called attention to the opportunities this form of lighting offers to central stations. Such lighting should include a city sign with some striking motto or slogan. He said that street arches are hopelessly ugly and out of place by day, and that if festoons of lamps must be used, it is far better to run them parallel with the curb than from post to post. The use of wooden posts and cheap construction should also, he said, be discouraged.

COMPARISON OF ARC LAMPS.

In a paper entitled "Magnetite and Flaming-Arc Lamps Versus Open and Enclosed-Carbon Arc Lamps for Street Illumination," Mr. W. D'A. Ryan, of the General Electric Company, gave a graphic comparison of the 9.6-amp open arc, the 6.6-amp enclosed arc, the 4-amp luminous arc, the 6.6-amp luminous arc and the 6.6-amp flaming-arc lamp with vertical electrodes. In the order here indicated, these lamps give 0.8, 0.9, 1.1, 1.4, and 3.6 mean spherical candle-power per watt, or 1.2, 1.7, 1.7, 2.6, and 5.8 mean lower hemispherical candle-power per watt. At a distance of 250 ft. from each lamp the illumination would be 0.0041, 0.0041, 0.077, 0.016 and 0.031 ft.-candles. The distances for equal illumination would be 250 ft., 285 ft., 315 ft., 475 ft. and 637 ft.

Test results, such as just outlined, seem to indicate that one 6.6-amp flame-arc lamp is equal to two 6.6-amp luminous-arc lamps, four 4-amp arc lamps, five 6.6-amp enclosed-arc lamps and seven 9.6-amp open-arc lamps when used for street illumination.

In reply to questions by Messrs. H. Almert and Farley Osgood, Mr. Ryan said that each of the above lamps was assumed to be operated at a normal e.m.f. of from 70 volts to 80 volts, direct current. In the most highly efficient lamp use is made of specially treated carbon electrodes, which cost from $20 to $30 per year more than do the electrodes for the 6.6-amp luminous-arc lamp.

INDUSTRIAL LIGHTING WITH INCANDESCENT LAMPS.

A paper by Messrs. J. D. Hoit, P. F. Bander and H. S. Hall, of the National Electric Lamp Association, Cleveland, explained methods by which high-efficiency incandescent lighting can be used to the advantage of the central station as well as the local industrial consumer. The authors recommended the application of the proper illuminating engineering principles in order that the lighting in industrial establishments may be obtained with the highest degree of satisfaction. Under these conditions the cost of central-station service is so low that isolated plants are unable to exist in competition.

DISCUSSION.

In discussing the paper, Mr. H. J. Gille said that the paper was a valuable contribution to the literature of the industry. The paper should be used as a text-book of the methods to be employed in securing industrial lighting. He remarked that work such as this should be highly appreciated by the members, to whom it will prove particularly valuable.

THE TUNGSTEN LAMP.

The report of the lamp committee, Mr. W. F. Wells, Brooklyn Edison Company, chairman, deals principally with the type of tungsten lamp which some manufacturers have labeled the "Madza" lamp. It is stated that further improvements which are contemplated in the manufacture of this type involve the use of a drawn-wire filament. The report recommends that for residences, office desk lamps or any use where smaller units are desired, 25-watt and 40-watt lamps are the most desirable. For cluster work in groups of three to six for the lighting of large areas, such as stores, auditoriums, etc., the 60-watt lamp is best adapted; this lamp, however, should be frosted, unless used with a special globe to tone down the intrinsic brilliancy of the light. For small stores requiring inexpensive wiring and with a limited number of outlets, the 100-watt lamp is most economical, as two of these would cost only about one-half the same capacity in 25-watt lamps; these lamps should have proper shades and the bowl frosted, except where the customer requires brilliant light instead of illumination. Lamps of 150 watt, 200 watt and 250 watt sizes have been used in special cases for replacing arcs or where large units are called for. It is said that until recently tungsten lamps of all sizes were made to operate at 1.25 watts per candle-power, but it was found that on this basis the life of the small lamps was too short and that of the large lamps too long for the most satisfactory service. To provide for the condition lamps are now manufactured to operate at higher watts per candle on low candle-power, and at lower watts per candle on higher candle-power, thus giving approximately a uniform life for all sizes. These lamps are marked with three different voltage ratings, which on the basis of an average life of 1000 hours corresponds to 1.33 watts, 1.39 watts and 1.45 watts per candle respectively for a 25-watt lamp: 1.25 watts, 1.30 watts and 1.35 watts for a 40-watt lamp; 1.20 watts, 1.25 watts and 1.30 watts for a 60-watt lamp. The specific consumption increases with the watts, the figures for a 250-watt lamp being 1.15, 1.20 and 1.25.

Referring to the method of introduction, it is said that the policy generally adopted by central stations has been to sell new lamps to consumers at prices approximating actual cost; even at these low prices, losses from breakage and delivery are partly reimbursed by the elimination of free lamp renewals. In Brooklyn and Detroit a flat rate has been made for the installation of lamps, fixtures and wiring. In Chicago, Philadelphia and Kansas City clusters are rented to customers on a monthly basis, and companies in other cities, including Rochester, have developed a maintenance scheme whereby lamps are kept in good condition at a fixed price per month. A method of installation on 30 and 60 days' trial has also proven satisfactory.

As to the effects of the tungsten lamp on present revenue, it is stated that the experience of companies which have favored the use of tungsten lamps has been that at first there is a noticeable decrease in revenue, but as a rule the customer purchases illumination to fit his purse, and is apt within a short time so to increase his installation as to approach his original expenditure for light. The reduced cost of light brings additional customers, and the effect on the total revenue will no doubt be an ultimate increase. Reports from companies indicate that a very large amount of new business has been obtained from customers who were formerly exclusive users of gas, the tungsten type of lamp making it possible to compete satisfactorily with gas at prevailing rates.

There was no discussion of this paper.

Transformers and Meters.

MODERN TRANSFORMERS

In a paper entitled "Some Interesting Points About Modern Transformers" Mr. E. G. Reed, of the Westinghouse Electric & Manufacturing Company, discussed numerous constructional features of modern transformers. The author gave reasons why large low-voltage units should be built of the shell type and small high-voltage transformers of the core type. The dividing line in each voltage class comes at larger and larger sizes as the voltage increases. Each class, therefore, has a perfectly legitimate field and neither is adapted for universal application. The author contended that those who advocate the use of either the shell or the core type exclusively for all transformsers have evidently not had an opportunity to become thoroughly acquainted with both. The comparison of air-cooled and oil-cooled transformers brings out the increased weight and cost of the air-cooled design without any commensurate advantage aside from the reduced size and alleged lesser fire risk for the latter. In a comparison of transformers that have a magnetic circuit without gaps, with those having magnetic circuits with an increased number of joints and different relative position of these gaps, the very great importance of carefully studying these points was indicated. Since the effect of the number of joints and their position becomes most important at the point of saturation, the most advantageous conditions must be secured. These facts, together with many others, must be studied in order to get the best results with modern grades of steel, which, while giving a lower iron loss, are more prone to eccentric behavior under various conditions. Extreme care and watchfulness are required to get low and uniform results from iron.

Impregnation of transformer windings is becoming quite general, and to the improved quality of gums is largely due the successful operation of modern transformers. The absolute necessity of uniform penetration and thorough drying was emphasized. Examinations of a considerable number of transformers failing in service through a number of years were stated to indicate that the greater number which fail are overloaded. A lesser number become short-circuited through moisture, and a few fail from defects having no adequate explanation. The conditions of service on small transformers are such that burn-outs from both overload and moisture are not only possible but normal under average central-station practice.

There was no discussion of this paper.

INSTRUMENT TRANSFORMERS

"Precautions When Using Instrument Transformers" was the title of a paper by Mr. L. T. Robinson, of the General Electric Company, in which was discussed the accuracy which may reasonably be expected of instruments used in combination with transformers. The author stated that instrument transformers should not be employed without accurate knowledge of their performance under the actual conditions of use. Such knowledge may usually be obtained with sufficient accuracy from average curves of the type used, supplemented if need be by a few points checked on the actual transformer. This, of course, involves a very close agreement between the individual specimens of a given type, which agreement can be secured. It is possible to procure transformers which will give results that are accurate and which will remain so even on low power-

factor. These same transformers may, however, be so misused as to give results much in error.

DISCUSSION.

In reply to a question by Mr. C. G. Durfee as to the probable error to be expected when using instrument transformers interchangeably, Mr. Robinson said that with instrument transformers of the latest type the error should not exceed 0.5 per cent.

METER REPORT.

The report of the committee on meters, Mr. G. A. Sawin, New Jersey Public Service Corporation, chairman, comprises 164 pages. With the exception of a draft of a "Meter Code," comprising 92 pages, the matter of the report consists of sections of greater or less length, treating, without interconnection, of the following subjects: Necessity to maintain accuracy; new forms of meters; devices for meter installation, in which are described and illustrated various devices to facilitate the installation, testing and replacement of meters, and to make them proof against theft of energy, views of some meter equipments and an instruction sheet being included; meter testers' tools and appliances; reading meters; meter shop; serially numbering meters; flat rates; legal requirements, under which head are included the rules relating to meters and meter testing of the Massachusetts, New York, Wisconsin and Vermont Public Service Commissions, and also statutes or ordinances on the subject enacted by the State of North Carolina, and the cities of Baltimore and Newark, N. J.

The draft of a meter code is arranged under the heads of: Definitions; standards; metering; specifications of meters and of auxiliary devices; installation methods; methods of test; system tests. The sections on specifications of auxiliary apparatus, installation methods and system tests are omitted, being still under preparation.

DISCUSSION.

Mr. F. Y. Vaughen expressed the opinion that the meter code, as prepared by the Electric Testing Laboratories under the instruction of the joint meter committee of the Association of Edison Illuminating Companies and the National Electric Light Association, should be generally adopted by the central stations of the country.

Mr. Joseph B. Seaman said that the Philadelphia Electric Company has obtained very satisfactory results from testing meters by comparison with a rotating standard when making use of a portable load-box which allows one man to attend to all the details of testing.

Mr. Paul Lüpke called attention to the relatively small importance of knowing the exact amount of energy consumed by the small customer, and questioned the advisability of expending much money in insuring a very high degree of accuracy in the meters.

Mr. C. G. Durfee claimed that the exhibit made by the meter committee was so valuable from the instructional point of view that it would be to the advantage of many central stations to pay the expenses involved in having their meter men visit the exhibit for the purpose of learning how to install test and adjust the various commercial types of meters.

In closing the discussion, Mr. Sawin voiced a general demand for a low-priced meter, having a fair degree of accuracy, for use on the premises of the small consumer.

Miscellaneous.

THE PUBLIC AND THE WATER-POWERS.

In an address entitled "The Public and the Water-Powers," Mr. Henry L. Doherty discussed the bearing of the development of water-powers upon the conservation of the fuel supply. He remarked that to withhold water-powers from development, simply because some Government official is not satisfied with the personality of the men behind the development enterprises, tends to defeat the conservation of the natural resources rathen than to aid the movement. No matter who develops the water-powers, the energy obtained must be sold at a price which will benefit the consumer or he will not buy it. If the problem were carefully and honestly discussed, it would be the universal opinion that the Federal and State Governments should lend every possible encouragement to the development of the water-powers.

DISCUSSION.

Mr. J. R. McKee described in detail the legal difficulties attending the obtaining of permission to conduct hydroelectric enterprises, and stated that some action should be taken tending to educate the public concerning the true conditions.

Dr. C. P. Steinmetz claimed that the improper and burdensome legislation under which hydroelectric undertakings labor is not due to lack of good intentions on the part of the Government officials, but can rather be attributed to lack of information. The legislators should be educated to a proper appreciation of the facts in order that laws may be framed for safeguarding the investments of those interested in hydroelectric developments while regulating the disposal of the energy obtained from the developments. The legislation should be constructive rather than destructive.

Mr. W. B. Jackson remarked that the association could do excellent work along the line of educating the people about water-power and the conservation of resources.

Gen. Irving Hale outlined the bearing of conservation on the development of agriculture by irrigation in the Western States, and claimed that the Government should not tax the West for the benefit solely of the East. Each state should be allowed to control the water-power development within its boundaries without dictation from the Federal officers.

Mr. C. F. Scott remarked that the old laws formed before hydroelectric developments were undertaken are not applicable to present-day conditions and should be modified accordingly.

Mr. D. H. McDougall outlined the franchises granted to the development companies which operate under a 99-year agreement, according to which the rate is to be adjusted at the beginning of each 33-year period.

TWENTY-FIVE YEARS OF CENTRAL-STATION COMMERCIAL DEVELOPMENT.

The address on anniversary day of Mr. Samuel Insull on "Twenty-five Years of Central-Station Commercial Development" opened with a reference to the earlier history of the association. In 1885 there were not over 80 central stations in the country engaged in serious central station business, representing a total cash investment of, say $10,000,000. At the present time there are upward of 6000 central stations in the United States, representing a total capital of over $1,000,000,000. The first central station in this country was started at Appleton, Wis., August 20, 1882, just two weeks before the Pearl Street station of the Edison Electric Illuminating Company was started in New York City. The latter company, however, was the first to project a central station system, although Appleton can claim the credit of putting in operation the first central station plant. The first investment in the New York Edison Company was $1,000,000, on which dividends were paid before additional capital was raised by the company.

In sketching the technical engineering advances in central station apparatus to date, he said that however far the commercial development of business has been forced by the work of the engineers, and however far the necessities of the salesmen and the business managers have forced the technical developments, the fact remains that as the possibilities of economic investment and economic production have increased, the business obtained and the energy distributed have also increased by leaps and bounds, so that it is no uncommon occurrence for a central station company to double its output every three or four years. In the early days of central station business rates were high, and it was not until the early nineties that any of the managers of large central-station properties

appreciated the fact that if they desired to place the business on the basis of a general public necessity, they must rearrange rates on such a plan as would give the long-time consumer, the man who used the central station company's investment most steadily during the year, the lowest possible price; and the recognition of the necessity of meeting this condition may possibly have had as much to do with reducing operating costs, interest and depreciation, as have the wonderful work of the inventors and the marvelous skill of the engineers. The enormously rapid growth of the central station properties, large and small, of this country, largely results from liberal methods of dealing with consumers—of an appreciation of the proper method of selling.

Mr. Insull considers that the younger men should bestow upon the commercial side of the business as much, if not more, thought than upon the technical and construction side of the central station. While it is comparatively easy to obtain first-class operating men, and not a matter of great difficulty to obtain engineers to design and build central-station plants and systems, it is a problem to obtain technical men who have made a thorough study of commercial conditions, with a view to taking part in the commercial development of the business. He considered it to be desirable for the technical schools to give greater prominence to the commercial side of the central station business, and when qualifying their students in electrical and mechanical engineering, to teach them also to operate. He said that the regulation of the business and methods of financing would hereafter be subject more and more to governmental supervision in some form or other. This demand for supervision is an appreciation on the part of the people of this country that the destructive effect of competition in public service business ultimately means greater burdens on the community, through the maintenance of high rates to give a return on the excessive capital tied up as the result of duplication of plants. While station men will not like to be hampered by the rules and regulations established by commissions created to watch over their operation, the further these commissions go into the central station business, the more will they be convinced that best results can be obtained only by regulated monopoly. The result will be that monopoly of the business will be secured, securities will stand in higher credit, and new capital will come flowing into the coffers for the extension of business. Mr. Insull added that he does not view with any alarm the proper regulation of central station business, but feels that its ability may be greatly increased thereby. Referring to the desirability of fostering good relations with the community in which a central station operates, he said that no little damage has been done to the corporate interests of this country by the action of some officials of corporations who seem to have concern only for the profit of the moment, and little or no concern for the future permanency of their investment. The central station manager should look upon himself as a semi-public official, and should conduct his affairs with more of the true conditions governing commercial development. He advised young engineers engaged in the operating side of the business to familiarize themselves with commercial conditions, to give thought to this side and qualify themselves to take part in the sale of the product of the company; for if they will devise new methods of selling the product, new methods for obtaining consumers of the energy produced by the central station, then they will stand a chance of achieving distinction and profit far greater than most of them can achieve in the operating and purely engineering side of the business.

Mr. Insull said that the real function of the central station company should be to produce all the electrical energy needed in a given community or given area for electric light and heat, industrial power, electric pumping, electric traction, and railroad terminal electrification. Central station companies should also endeavor to cover large amounts of territory outside of the municipality in which they are established. This function might even be extended to sharing in the electrification in general of steam railroads, the financial burden of making the change being divided—steam railroads providing the necessary capital for electrifying their right of way and for their rolling stock, and the central station providing the capital for building large generating stations and transmission lines to convey the electrical energy to the railroads, and also to other consumers along the right of way.

Referring to the relations of the central stations with communities, in which they dealt fairly with each community, so as to secure a reputation for absolutely fair and impartial dealings, he said the same doctrine should be preached to all subordinates, who should be required to carry out this policy in their dealing with the public.

ELECTRICAL PROGRESS

Mr. T. Commerford Martin, executive secretary, in his report on progress gave statistics and current information concerning the various phases of the central-station problem. The main heads of the report are as follows: General growth; conditions and data abroad; regulation, rates and franchises; a few rulings on rates, etc.; incidental legal decisions; new stations and plants; features of street lighting; metallic-filament lamps; arc lighting; features of service; electric automobiles; progress in refrigeration; electric heating; motor service; miscellaneous work and general advancement. The report constitutes a valuable summary record of the things done during the last year in all branches of the central-station industry. The development in California of central stations serving large territories shows financial results, which, compared with the results obtained in the East by small central stations serving small communities, lead to the conclusion that future progress lies in the consolidation of these small companies into larger ones serving larger territories. He says that the 358 central-station companies operating in New York State could easily be replaced by from 20 to 25 plants. Among the new stations, plants have been selected which involve important departures from older standard practice. Among these may be mentioned the exhaust-steam turbine plant of the Interborough Rapid Transit Company, of New York; various gas-producer plants, oil and wood-burning plants, and several notable water-power developments. Street lighting has made important progress, both by the development of new illuminants and by improved fixtures and methods of utilizing the light. The development of illuminants, such as metallic-filament lamps, the titanium-carbide arc and the quartz-tube mercury-vapor lamp, is briefly summarized. In the line of new business, much interesting information is given concerning the results obtained in various localities with electric automobile charging, refrigerating, electric heating and motor services.

TERMINOLOGY.

The committee on terminology, Mr. W. H. Gardiner, of New York, chairman, submitted a list of definitions for immediate publication and distribution in order to invite criticism, all suggestions to be filed before Nov. 1, 1910. Among what appear to be new terms are the following: Block rate—A method of charging for electric service at different successive rates per kw-hour consumed, each successive rate applying only to a corresponding successive block or quantity of the total current purchased during the period covered. Corrective motor—A synchronous motor running either idle or under load, whose field may be varied so as to modify the power of the circuit to which it is connected, or through such modification also influence the voltage of the circuit. Dispersion factor—The factor applied to light intensity after dispersion, which gives the intensity if the dispersion agent were removed. High frequency—A frequency so high that the Ohm's law does not apply even approximately. Intensified arc lamp—An arc lamp with one of the carbons of small diameter to give a large current density per unit of arc, on which the arc plays thereby to intensify the light. Operating time factor—The ratio of the number of hours of operation to the number of hours in the interval considered. Operating time load factor—The load factor considered only during the time of operation. Step

rate—A method of charging for electric service at definite specified rates per kw-hour consumed.

A number of "factors" are defined as follows: Capacity factor—The ratio of the average station output to the maximum capacity of the station in kilowatts. Demand factor—The maximum connected kilowatts of capacity divided by the actual kilowatts of demand. Diversity factor—The relation between the simultaneous demand of all individual consumers and the sum of the maximum demand made by these consumers. Effective load factor—The main load of a part of the system determined by the load at the time of the system's maximum. Load factor—The average load over any given period divided by the highest average load for any one minute during the same period. Simultaneous demand factor—The ratio of the simultaneous demand and the connected load.

DISCUSSION.

Mr. A. S. Loizeaux claimed that in so far as it was possible to do so, established rules, such as those of the American Institute of Electrical Engineers, should be followed, exceptions being made only in cases where a marked improvement could be introduced.

Dr. C. P. Steinmetz explained that the committee had experienced difficulty in deciding what terms should be standardized, and the ones offered in the report were brought forward tentatively with the hope that the members would express their thoughts as to the words to be selected for standardization or definition.

CENTRAL-STATION FIRE INSURANCE

In his report as insurance expert of the association, Mr. W. H. Blood, Jr., of the Stone & Webster Engineering Corporation, states that gasoline competition continues to vex and seriously annoy certain localities, especially in Colorado, and the charge is made that the underwriters waive deficiency charges in many gasoline installations, while they enforce to the letter the code requirements for electric light wiring installations. He said that a movement is on foot to take away from stock companies the insurance business of the electric light companies, and unless the underwriters change their method of procedure they will find they have been pursuing a short-sighted policy. He asked the co-operation of the members in supplying information giving accounts of gasoline explosions and fires. When enough information has been secured, a pamphlet will be published and placed at the disposal of members troubled with serious gasoline competition.

The author stated that he had secured from various sources enough information to make him reasonably sure that central-station insurance rates are about twice as high as they should be. The rate throughout the country varies greatly, some rates on buildings being as low as 25 cents, while others are up to nearly $2.50. The rate on contents is always higher than the building rate. He states that a conservative estimate is $1 per $100, or 1 per cent, as an average for plants and contents throughout the United States, corresponding to an annual premium of $3,305,000. As the underwriters use 45 per cent of the premiums for expense of management, commission, profit, etc., the reserve of the above sum for losses is, therefore, $1,817,750. Nevertheless, records show that in the worst year the underwriters have had, they paid out in losses on electric light and power plants but $619,000. Making some allowance for conflagration hazard and for inaccuracies in estimate, it is evident that central stations are paying fully twice as much for insurance as they should. He added that, although he sent these figures to many of the leading insurance representatives of the country, thus far no criticism of them had been offered. The report includes a resolution for presentation at the convention as follows: That fire insurance premium rates paid by electric lighting companies at large are fully twice as high as warranted; that the convention directs that the matter be called to the attention of fire-insurance companies throughout the country; that a demand be made for an investigation by them of existing rates, with a view to a reduction commensurate with the premiums received and the risk involved; and that every member of the association shall make a positive demand for a material reduction in rates.

DISCUSSION.

Upon motion of Mr. Osgood, this report was approved, whereupon Mr. Blood offered the following resolutions which were adopted:

Whereas, In the thirty-third annual convention of the National Electric Light Association, in St. Louis, May 24, 1910, certain figures were presented by our insurance expert, which tend to show that the fire insurance premium rates paid by the electric lighting companies of the country at large are fully twice as high as the low ratio warrants. Be it

Resolved, That this convention makes notes of this fact and directs that the matter be called to the attention of the fire insurance companies throughout the country, and that a demand be made for an investigation by them of existing rates, and that a reduction be made commensurate with the premiums received and the risks involved. Be it further

Resolved, That copies of these resolutions be furnished every member company of this association and that through them the insurance companies writing the various risks be informed of the action of this meeting, and that a positive demand be made for a material reduction in rates.

THE QUESTION BOX

The Question Box was the subject of two reports, one by the present editor and the other by past editors, relating to the revision now under way. Mr. John C. Parker in his report said that editing the Question Box had become a work of such proportions that the services of a permanent editor should be secured and the work carried on from the association headquarters. Mr. Paul Lupke and Mr. Alex. J. Campbell, past editors, reported on the progress of the work of revising the Question Box. This work is being carried on by 25 associate editors, and while excellent progress has been made, it is not yet completed. It is hoped, however, that the work will be finished in time for the revision to be printed as a part of the *Proceedings* of the St. Louis Convention. The committee states that as the revision proceeds it is evident that the work is becoming less and less a mere revision of the Question Box, and more and more the development of a central-station operator's handbook, though distinctly different from other engineering handbooks. The work will, in fact, be to the whole field of central-station work what the "Solicitor's Handbook" is to the new-business department. While the first edition will prove a useful and handy reference book to the central-station man, it will necessarily fall short of the standard that may be reached in succeeding editions.

DANGERS OF SPECIALIZATION

In a paper entitled "Superspecialization," Mr. Paul Lupke epigrammatically pointed out some of the dangers of the central-station man becoming so highly specialized as to ignore the necessity of keeping in touch with all the work of his company. While admitting that the great expansion of knowledge and the complexity of modern business conditions impose specialization, he said that one should not keep his back bent forever in his own narrow furrow, as by so doing he will lose his sense of direction and run the risk of being brought up sharply against a dead end. Now and then he should straighten up, look over the walls he has thrown around him and take a calm and considerate general view. He referred to the blighting bane of hide-bound department narrowness, which tends to cause one to constitute himself into a stronghold surrounded by a spiked fence, which, while barring interference, also repels helpful suggestions as well. Out of this condition grows a tendency toward diminished interest in the company as a whole. The influence of excessive specialization on the individual employee is a tendency to develop an exaggerated egò, for the narrower a man's horizon becomes, the greater his own importance looms up to him within. When he begins to imagine that his part, no matter how great it is, is the only important part, he is a failure and simply consigns himself automatically to the category of

little men. It should be kept in mind that there are always more little men than little jobs, and there are always more big jobs than big men; and big jobs must be above any one single department. The specializing process of a large department inclines toward rigid mechanical treatment of men, and while in general we are, voluntarily or otherwise, treating men less and less brutally like machines, we are, nevertheless, treating more and more men, unwittingly perhaps, subtly like machines. If a human being is treated as a machine, at unexpected moments the thing will think in spite of the employer and then, not being used to the process, its actions are beyond all calculations and the results only too frequently disastrous. The fact that a corporation has no soul lays upon every employee, high and low, a duty to demonstrate clearly on every occasion that he himself has one. There is no better way of exercising the spirit of true loyalty to one's company than by quietly and persistently doing one's part in guiding everything that needs correction into the proper channel for immediate attention, but without exacting instant and specific credit for every little act of this kind. No concern can live and prosper that does not recognize and properly reward true loyalty.

EDUCATING CENTRAL-STATION EMPLOYEES

Prof. Sydney W. Ashe, of Brooklyn, N. Y., presented a paper entitled "Educating Central-Station Employees," which contains an outline of the results obtained from courses of instruction given by the author to employees of central stations in Brooklyn, New York, Boston and Baltimore. Suggestions for the arrangement of such courses and the functions thereof are set forth briefly.

CENTRAL-STATION POWER FOR FARMING AND IRRIGATION

In a paper entitled "Electricity on the Farm and the Influence of Irrigation from a Central-Station Standpoint," Mr. Herman Russell, of the Rochester (N. Y.) Railway & Light Company, pointed out a new line of activity for central stations located in large cities which are surrounded by farming country. As a specific instance, he states that the Rochester Railway & Light Company, supplying about 200,000 people with electric energy, has about 10,000 hp of machinery lying idle between the months of April and October every year, and that during these months from 10 o'clock at night until 6 in the morning there is an additional 10,000 hp of machinery which is not in service. Increasing difficulties in securing competent farm labor and increasing value of farm products have made it desirable for farmers to use electric energy, or some other form of motive power, as an assistance in obtaining a maximum production from the land. Among the uses to which electric energy may be put are mentioned lighting, pumping water, driving conveyors, churns, separators, feed cutters, feed grinders, milking machines, hoists, spraying machines, machine tools, etc. In addition to these miscellaneous uses of electric energy the author suggests the possibility of developing irrigation pumping as an important non-peak load, even in humid climates. Irrigation of this kind may be considered as drouth insurance, and with the increasing value of products and the tendency to intensive farming, the loss of crops due to an unexpected drouth is such a serious matter that insurance of this kind becomes very desirable. Aside from the value of irrigation in carrying crops through a dry season, it makes possible a maximum production, due to ability to control to a certain extent the water supply to the crops. A great deal of work in the development of irrigation load for central stations has been done in the West, but practically none in the East. Reference is made to recent articles in the *Electrical World* by Mr. E. C. Reybold on the irrigation campaign of the Northern Colorado Power Company. Mr. Russell looks forward to a time, not far distant, when distribution lines for supplying electric energy will be as common throughout the country as telegraph and telephone lines are to-day, and when the present enormous idle investment of central-station companies will be employed in making farms more productive.

DISCUSSION.

Mr. M. C. Osborn said that the conditions varied greatly as to irrigating pumping. For example, in California irrigating pumps are run many months a year, while in Washington the pumping season is short. As a consequence, in Washington they are obliged to make a high service charge of $3 per kw-month. The energy charge is low, being 0.5 cent per kw-hour. This figures out for each 1-ft. lift 2.5 cents per acre-foot of water per year.

Commercial.

EXECUTION OF ORDERS

Mr. Clare N. Stannard, of the Denver Gas & Electric Company, presented a paper entitled "Prompt Execution of Orders." Promptness, he said, should be an essential quality of a commercial department. A commercial man should use promptness in discovering and remedying poor service. A reputation for promptness is often of monetary value, having an influence on the increased revenue, as it indicates a desire on the part of the company to look after the patron's welfare. A system of commercial promptness is outlined. Upon a customer entering an office he should be received by a man, perhaps styled director, who would direct him to the proper window, and there should be a sufficient number of clerks at the window to handle the people without requiring a customer to stand in line any length of time. All applications taken in the forenoon should be written up so that they may be executed promptly in the afternoon, and all orders taken in the afternoon should be similarly handled so as to be executed the following forenoon. If a consumer desires to make a complaint he should be very promptly taken care of by an intelligent, competent and experienced employee. All complaint orders should be promptly executed the day received. In large companies a night force of men might be employed with advantage, who could almost immediately answer special and emergency calls. It is advisable to call together occasionally the employees of the company who come in direct contact with the public, and at such meetings timely and interesting talks and discussions should be given, and the policy of the company outlined.

DISCUSSION.

Mr. Paul Doty, of St. Paul, said that courtesy demands promptness. Promptness also adds to a manager's peace of mind, as he can then have the feeling that business is being attended to promptly. A good company should be like an eight-day clock—that is, it should be able to run some time without the presence of the managers and heads of departments. If a company's manager is really aiming to conduct the business for profit, there is no danger of the superspecialization which Mr. Lupke had warned the convention against in the first session, or of the frenzied new-business methods which take on unprofitable classes of business for the sake of making a large showing in connected load. Mr. M. C. Osborn, of Spokane, spoke of loose methods formerly used in his company in keeping track of orders for repairs given to repair men. Now when a trouble call comes into the "fix light" department, as it is called, the girl who receives the orders marks on the order blank the nature of the complaint opposite a list of the common complaints marked on the order, gets the address and name, and immediately stamps the memorandum with a time stamp. This order is treated with as much respect as if it were a check for money, until it is returned to the manager of the department. If, for any reason, the repairs cannot be made within one hour, the reasons must be filed so that the manager of the department can know at any time just what orders are outstanding and the reasons.

Mr. Douglass Burnett, of Baltimore, said with reference to connecting up new consumers that it is desirable to make a classification from experience of the probable time required to do any given class of work so that when dealing with consumers the maximum probable time required can be named. Mr. R. W. Clark, of Minneapolis, called attention to the fact that some companies are creating in their business offices the peak-load

condition which they are striving in every way to alleviate in their power stations. He referred to the congestion of work caused by reading meters and billing once a month only. In Minneapolis meter reading is carried on continuously, a certain number each day, so that the load on the meter readers and office force is equalized. By having such consumers as come to the office to pay bills come in a few at a time better attention can be given to them than if there were a rush. There is also more opportunity to sell them additional electrical appliances. He recommended studying the number of operations which must be performed in getting an order for work through an organization.

Mr. M. S. Seelman, of Brooklyn, said that delays had been reduced to a minimum so far as those within the organization were concerned in his company, but there is still considerable annoyance and delay caused by failure to secure prompt inspection by the fire underwriters. He said that he would like to hear a symposium on the subject to learn how much delay there is in getting inspections in other cities, so that if there is unnecessary delay in some cities it may be eliminated. Mr. M. O. Dell Plain, of Syracuse, showed the advantages of having a separate room where those having complaints can be invited in to sit down and talk over the matter quietly. He deprecated the tendency of some salesmen to promise more orders than can get prompt action. Mr. James T. Hutchings, of Rochester, said salesmen should find out the condition of a job before marking an order rush. It is not conducive to enthusiasm in the operating department to send out a man on a motorcycle to connect up a house on a rush order and find that the wiring is not completed.

INSPECTION OF CUSTOMERS' SERVICES

Mr. A. G. Strickrott, of the Schenectady (N. Y.) Illuminating Company, in a paper entitled "Periodic Lamp Renewal and Customers' Service Inspection," related the experience of his company in connection with these branches of its work. This company has 10,300 lighting customers, of whom about 85 per cent are residence owners. There are 210,371 individual lamps, the lighting load being 9843 kw. During a recent inspection it was found that certain of the lamps were giving as low as 50 per cent of their rated candle-power and several as low as 30 per cent. As a result of the conditions discovered, a plan for inspecting all customers' installations was put into force. In many cases the lamps were changed to ones of different candle-power with resultant improvement in the lighting conditions. The men making the inspections were supplied with flatirons and other devices, and they were the means of selling quite a number. They thus advertised and demonstrated these devices, even when sales were not made. They also promoted the use of larger lamps and made minor repairs and changes for the betterment of the service.

DISCUSSION.

The paper by Mr. Stickrott was presented in his absence by Mr. C. S. Van Dyke. In its discussion Mr. W. H. Gardiner said that the cost of renewals on carbon lamps is about 0.75 per kw-hour, renewals being made at 500-hour intervals. When renewals are made at 1000-hour intervals the inspections may be made too infrequently and a certain expense may be occasioned by the extra inspections involved.

Mr. P. S. Millar called attention to the bearing of the voltage of the circuit upon the candle-power of lamps, and stated that tests for comparative purposes should be made under service conditions.

Mr. H. B. Gear explained in detail a plan for periodic lamp renewals tried in Chicago, which was abandoned within a few months. Customers would frequently insist on the renewal of lamps which were yet in good operating condition. No attempt was made by the renewal force to sell energy-consuming devices.

CENTRAL STATION COSTS AND HIGH-EFFICIENCY LAMPS

In a paper entitled "High-Efficiency Lamps: Their Effect on the Cost of Light to the Central Station," Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gives an analysis of central-station costs, which are then related to the use of high-efficiency incandescent lamps. Under the latter term the author includes graphitized-filament lamps, tantalum lamps and tungsten lamps. In opening, an account is given of the principles of cost of electric supply laid down by Dr. John Hopkinson in 1892, and also embodied in the "readiness-to-serve" system of Mr. H. L. Doherty. In tracing the relative amount of attention given to the rate question from the time of Dr. Hopkinson's papers, reference is made to articles cited in the "Engineering Index." From the figures given by Mr. Doane it appears that these notices represent very inadequately the numerous articles published on the subject in electrical periodicals, particularly during the past five or six years. The paper includes a very valuable table giving an analysis of central-station costs, the data for which have been procured during the past two years by members of Mr. Doane's engineering staff. The analysis applies to (a) and (b), two large central stations giving free renewals; (c) the average of about 70 stations in the East, and (d) the average of about 40 stations in the West. The central-station cost is divided into general, distributing and generating expense, taxes and insurance, depreciation, interest and dividends, which items are represented in percentages of the total cost. In addition, the distributing and generating expenses, interest and dividends, and total are represented in percentages of the output, demand cost and consumer's cost. The demand cost expresses the cost involved in supplying the maximum demand. The consumer's cost is that chargeable to the consumer whether or not he actually uses any current.

The figures show, in general, that the general expense is greater for the two large stations than for the two classes of stations in the East and West, while the generating expense is only about one-half. Taxes, insurance and depreciation are larger for the two latter classes, while the first two classes have some advantage in dividends. What are called the weighted averages of the station expenses of all the stations are as follows: General expense, 12 per cent; distributing expense, 14.4 per cent; generating expense, 23.9 per cent; taxes and insurance, 7.8 per cent; depreciation, 9.8 per cent; interest and dividends, 32.1 per cent. Of the total average distributing expense 47 per cent is due to output, 28 per cent to demand cost, and 24.1 per cent to consumer's cost; for generating expense, the two first-mentioned values are 72 per cent and 28 per cent; for interest and dividends, the respective values are 19.7 per cent, 63.7 per cent and 16.6 per cent, the total station expense being 30.3, 55.1, and 14.6.

A further analysis of cost shows that the coal consumed in a station does not depend directly upon the output, but in part upon the maximum demand. It is stated that the Massachusetts Commission report indicates that the average customer in that State consumes 1.5 kw at the time of maximum demand, while the report of the Wisconsin Commission indicates 1.8 for the average maximum demand. In Chicago, data offered last year in a paper by Mr. E. W. Lloyd shows that a Chicago lighting customer consumes 1.7 kw at the period of maximum demand. The analysis by Mr. Doane indicates that the load factor of the average consumer is 11 per cent, that of the short-hour user being 7 per cent and that of the long-hour user 20 per cent.

The data thus secured are applied to show the effect of the adoption of high-efficiency lamps. A table is given showing the costs of serving various consumers on the basis of the use of carbon-filament lamps, graphitized-filament, tantalum and tungsten lamps, each consumer being assumed to use the same total amount of light. Among the conclusions are that for the average small consumer using high-efficiency lamps, the reduction in his cost is in no sense comparable with the reduction in energy required for a given quantity of light. The increase of such consumers means an increase in proportion to the central-station expense for labor in connection with the distributing system, accounting, etc., designated consumer's cost.

The costs classed as the consumer's cost, which are the costs per customer for distributing the energy generated, are the

costs which concern the central stations to a constantly increasing extent. The investment in meters and the length of the line necessary to reach a customer, the location of meters to facilitate reaching and details of this character, will be of considerably greater importance to the station man than the efficiency of the generating apparatus. If the customer's cost can be reduced 50 per cent by the universal adoption of a cheap meter, a current-limiting device or something equivalent to either or both, etc., such a decrease would allow the central station to carry 80 per cent more customers with the same gross cost, at which time the cost per kilowatt would be no greater than at present nor the total average cost per customer on the basis of the assumption would be decreased to 36 per cent of the present total average cost per customer. When a station has added 80 per cent more customers its total cost will have again reached the present cost, but the cost per kw-hour will be about 60 per cent greater than at present. Even when the station again becomes fully loaded, the cost per kw-hour will be about 25 per cent greater than it is at present. Mr. Doane said that the possibility of the high-efficiency lamp being made more efficient as the weeks pass renders it necessary for the central station to adopt policies, programs and methods which not only will take care of the present high-efficiency lamp situation, but which will provide for any increase in efficiencies in the weeks, months and years to come. The situation contains a menace and a promise, a menace which cannot be ignored, a promise which must be fulfilled. The menace lies in the fact that the reduction in the cost of providing light to the average customer, can never be so great as the customer expects. He inevitably associates the two-thirds reduction in energy consumed with a two-thirds reduction in cost. The decrease in the cost of furnishing light with the high-efficiency lamps is almost entirely measured by the ability of the central station to take on additional consumers who can assist in bearing the fixed expenses.

The promise lies in the opportunity, for never in the history of the industry has there been the opportunity which now presents itself to the central station for increasing the number of its customers, decreasing the cost to each of them, and increasing profit to itself, through the use of the high-efficiency lamps.

DISCUSSION.

Mr. Alex. Dow stated that, although the high cost of the tungsten lamp and the fragility of the filament have tended to retard the introduction of the lamp, yet it is becoming a highly important element in the central station and its presence cannot be ignored in readjusting the rates for electrical energy. However, the results to be expected will not prove as disadvantageous as predicted by Mr. Dow, who ignored the highly important effect of heating and motor loads upon central-station earnings. In adjusting rates it is essential to distinguish between large and small consumers and between residences and industrial establishments. Moreover, it is improper to assume all consumers involve equal service costs. In many cases new residence consumers can be added without necessitating any increase in costs for mains. In fixing the rates it should be remembered that the minimum-bill plan has always proved unpopular and there is danger of provoking complaint by introducing a customer charge on the ground of discrimination against the small customer.

Mr. H. L. Doherty claimed that a central station must supply both a commodity and a service, and the rates for electrical energy should be determined in such a way as to take this fact fully into account. Under usual conditions the consumer cost is proportionately very large, and it is essential to establish equitable rates that will provide for any improvements that may be introduced in the efficiency of lighting units. Such improvements are not properly provided for in the present system of determining the rates for energy. As the number of customers of a station increases, the amount of generating apparatus for supplying the needs decreases. In a well-developed community the increased generating rating may be as low as 0.2 kw per added consumer. However, the amount of apparatus used at the consumer's residence is many times as great, so that the investment made by the consumer is much larger than that made by the central station.

Mr. H. W. Peck said that under the conditions existing at Rochester the consumer cost is 35 per cent; the demand cost is 55 per cent and the output cost only 10 per cent of the whole. In order to meet the new problems arising from the introduction of the high-efficiency lamps, it is necessary to revise the rates charged for energy. Difficulty is found in proportioning the expenses properly, For the good of all persons concerned the central stations of the country should co-operate in the revision of the rates.

SALES DEPARTMENT ORGANIZATION.

In a paper with the title "The Organization and Functions of a Sales Department," Mr. Theodore I. Jones, of the Brooklyn Edison Company, gives details as to the organization of a sales department capable of handling the business of a central-station company operated in a city of over 100,000 inhabitants. The subject is developed under the following heads: Titles; component parts of a sales department; the sales department tree; lines of authority; specialists; advertising manager; company publicity; care of the customer; clerical routine; general sales agent; co-operation. Mr. Jones states that the business-getting departments of central-station companies in the past have been known under various names, such as contract department, commercial department, "new business" department, sales department, etc., but of all these names he believes that of sales department most nearly describes the actual work done. The large industrial companies have a sales department, with a general sales manager as head, and there is no valid reason why a precisely similar organization in a company selling electricity should not be called by a similar name. Consequently, the title of general sales agent is suggested for the head of such a department; the title of district sales agent where there are district offices, and the title of salesman for the men in the field. The sales department would have cognizance of all contracts taken for light, heat and power; the selling or rental of apparatus consuming energy; the display rooms, electric shops, electric shows, etc., should be conducted by the selling force; advertising should be an important function of the sales department, which should have on its staff a live advertising manager As an illustration, the organization for a proposed department of the Brooklyn Edison Company is given. At the head would be the general sales agent, with a secretary, chief clerk, clerks, messenger and stenographer. His personal staff would consist of a district sales agent for each of the three districts into which Brooklyn would be divided; an advertising manager, power engineer, appliance manager and special salesman. The district sales agents would have as subordinates, salesmen for light, power and wiring. The special salesman would have cognizance of city lighting and new buildings. The appliance manager would have a demonstrator and wiremen. The power engineer would have charge of power sales. The paper considers in detail the duties of the various members of the organization.

DISCUSSION.

Mr. E. W. Lloyd, of Chicago, stated that the head of the contract department should be effectively in charge of all sales, but that co-operation with other departments is very essential. Men from the inspection department who come in contact with the public frequently must treat the public with the same courtesy that they would if salesmen. In Chicago it is the practice to refer all complaints over bills to the contract department when more than a certain amount of money is involved. In case the complaint is on the power bill, a commercial engineer is sent out who investigates the whole installation to see whether changes for economy should be made. Mr. L. R. Willis, of Boston, reported a similar organization in Boston to that in Brooklyn. The accounting department makes no effort to collect bills when some complaint over the bill is involved, this matter being placed in the hands of the sales department. A sales department representative visits all consumers having

a connected load of 30 kw and over at least three times in three months, the time of the visit being according to the judgment of the representative. Mr. M. O. Osborn, of Spokane, objected to the title "contract department," because people do not like to sign contracts. He suggested the name "application department." He also objected to the term "complaint department," and would call it "fix light department," "inquiry department," or something of the kind. Mr. Boddon, of Brooklyn, emphasized the importance of not having an applicant or a complaining consumer buffeted about from one man to another in the office to transact his business. One representative should deal with him, and if necessary the representative can take up the case with the various necessary departments. Mr. M. W. Offutt, of Schenectady, told of an experiment he tried of having two men canvass the town to get information about the consumers' connected load, or if not connected whether service is available, whether house is wired, etc. Incidentally the men learn of any complaints that may be against the company.

Mr. M. O. Dell Plain, of Syracuse, said that while a separate power engineer and power salesman might be desirable in large companies, they should be one and the same man in the smaller companies, because no salesman could be secured at a reasonable price who would have the necessary knowledge of the business to take up the entire proposition with the consumer. He would combine the salaries of the two men and get one good engineer and salesman. The actual testing necessary could be done by some minor employee of the operating department under the power engineer.

COMMERCIAL SIDE OF CENTRAL-STATION WORK

In a paper with the title "Latitude in Commercialism," Mr. Arthur S. Huey, of H. M. Byllesby & Company, presented arguments for the encouragement of a general commercial spirit in the central-station industry. The subject is covered in the following heads: Study People's Needs; Public Opinion and State Commissions; Co-operative Effort Versus Exploitation; Participation in Municipal Activity; Responsibilities of Commercial Departments; What the Central-Station Manager Ought To Be; Future Viewed with Encouragement. Commercialism in the central station is a force, he said, which will do as much as anything else to make popular the central station. At least 75 per cent of public ill feeling against public-service organizations has been caused by the failure of operating companies to take pains to please their customers. Mr. Huey welcomes the creation of State Public Service Commissions, because he sees in them great opportunities for good to the public and corporations alike. So far such commissions have proved mighty educating forces, and not a single State Commission has yet failed to be impressed with the chief claims of operating companies, and to base its decisions upon broad recognition of many principles which the companies have tried in vain otherwise to make the people understand. He states that no words are strong enough to denounce the central-station management which regards the community served as a mere field for exploitation; logically, the central station is a part of the economic scheme of the modern city, and it should profit in proportion to the co-operative value it returns to the community. A central-station company and its officers should be in the very front ranks of the wide-awake individuals and corporations who are planning and striving for municipal advancement. A central-station organization can do far more good for itself lined up with the commercial clubs, boards of trade and similar broad-gage civic bodies, than it can by patronizing the politicians and wasting valuable time in an attempt to manipulate political machinery. Mr. Huey believes that it is far more important that the central-station manager be a good man of business than a good engineer. If the two capacities can be combined in one man the acquisition is highly desirable, but usually the two kinds of special ability are not thus combined. He considers that as a rule the professional mind is not well suited to deal with purely public and business transactions. In conclusion, Mr. Huey says that the recent tendency has been to inject a genuine commercial spirit into operating companies, to meet the people a little more than half way and to put the central-station industry in tune with existing industrial and sociological conditions.

DISCUSSION.

Mr. E. W. Lloyd, of the Commonwealth Edison Company, Chicago, said that he did not think Mr. Huey had exaggerated when he said that at least 75 per cent of public ill feeling against utility organizations has been caused by the failure of operating companies to take pains to please their customers. He thought it desirable to reduce the number of men which must call on customers as much as possible, as too many different men calling to complete a connection is an irritation. He laid special importance on keeping track of the final disposition of letters and especially of telephone messages to see that consumers requests are looked after and not forgotten. It is a good plan to listen frequently to the talk between consumers and employees of the company going on across the counter in the contract department. A few years ago his company employed very young men to talk to consumers in the contract department. Now it employs more mature men, as the latter handle the public better, and the public prefers to talk to older men. Formerly in this department they had elaborate grill work with windows through which to talk to consumers. This grill has been removed and open counters substituted, which has a better effect on consumers than talking through a grill work. The company now extends credits to all householders.

Mr. T. I. Jones, of Brooklyn, referred to the fact that in the Hebrew districts in New York the cut-off man is the only man who can collect bills. It is not often that one finds a skilled engineer and a diplomat in the same man, but when such a combination exists he should be employed. Mr. C. N. Stannard, of Denver, brought out the point that a well organized new business department with men frequently visiting consumers establishes friendly relations which have an important effect in molding favorable public opinion toward the company. The company should keep its plants in such a condition that visitors can be shown through them like other notable industries of the city. He quoted from a recent editorial in a daily paper not specially inclined toward corporations to the effect that competition in telephone and electric light business is not at all desired. Mr. M. S. Seelman, of Brooklyn, told of his experience as a newspaper reporter 15 years ago in visiting the president of a large public-service corporation, and being told that the company had nothing to say regarding a recent occurrence in which the public was much interested, and that the company would continue to run its business in its own way without the aid of the newspapers. This was typical of the attitude of corporation managers 15 years ago, and is in striking contrast to the general attitude to-day when the statement of the company's side of a case is generally offered.

Mr. Douglass Burnett, of Baltimore, said that the telephone and the business counter are the chief points of contact between company representatives and the public, and it is all important that the public be favorably impressed at these points. He believed in Mr. Lloyd's plan of having an open counter and also in having information in such shape that a consumer can be supplied promptly with the information he wishes, then and there, without having to call later. Referring to the active part which officers of the company should take in public affairs, Mr. James T. Hutchings, of Rochester, referred to the fact that Mr. Searles, general manager of his company, is on the executive committee of the Chamber of Commerce. His company offers the services of its best engineer to confer with any manufacturers who are thinking of coming to Rochester to locate. Mr. H. Almert, of Chicago, agreed that elderly men do better in meeting the public on complaint work than young men. A complaining consumer's troubles increase as the square of the time he has to wait in the office before he can state his case.

THE ELECTRIC VEHICLE

Mr. Hayden Eames, general manager of the Studebaker Automobile Company, in a paper entitled "Electric Vehicle Opportunity," pointed out the community of interests of the central-

station man and the automobile manufacturer in the electric vehicle field. The last several years, he said, have witnessed some recognition on the part of central-station manufacturers of the fine opening for business in this field, and he believed that the time is not far distant when the general use of the electric vehicle may be expected to tax to the limit the existing central-station plants with essentially an off-peak load. The essence of the whole question of an increased use of electric vehicles lies in the education of the public as to their proper application, care and operation, and no one is in a better position to cooperate with the electric vehicle manufacturer in this educational work than the central-station man. It may be assumed that, except as producing an increased and especially satisfactory market for its energy, the central-station organization has no more interest in the manufacture and sale of electric vehicles than it has in that of any other commodity, and that the method of education is to be arranged upon this basis. It probably will be wise for central-station managers to maintain a permanent educational organization, thereby putting it in the position of a judicial protector of the local industry, and in a moral and positively commercial position from which it can exclude experiments and freaks, and protect the public from the passing use of novelties such as have from time to time during the past 10 years disturbed the power-wagon business. Generally speaking, however, educational work can be much better applied in disseminating as widely as possible the general principles governing the application of electric power wagons, and the considerations which should control the question of their adoption for any given purpose, with the ultimate idea that the expense of educational work can be discontinued when an adequate knowledge of the subject has become a matter of course among those interested. The heavy work of education has been going on for the past 10 years, and the problem now is to localize it, particularize it and bring it home to the user. Mr. Eames referred to the antagonistic mental attitude of wagon foremen, teamsters and similar classes to the substitution for draft-animal service of the electric vehicle. He said that no effort toward the general introduction of electric vehicles will count for much until this mental habit of the prospective user is broken down. No body of men, he added, is in as good or as strong a position to arouse a spirit of inquiry and fairmindedness toward the subject as central-station managers and their organizations. The paper discussed the question of wagon ratings, which the author says have been a prolific source of confusion. In different parts of the country wagon makers make their wagons differently, just as power-wagon makers and electric generator makers formerly rated their wares for competitive purposes. In closing, Mr. Eames said that, while no doubt every manufacturer would be glad to have the direct aid of the central-station in the local distribution of his vehicles, this could not fail to retard the local educational work, as it would no doubt stimulate large competitive interests to an active propaganda in favor of independent power stations. Under existing conditions, he said that the most healthy, strongest and most promising line of action for the central station will be to establish itself as a source of information, and to use the moral influence this will create to insure for their localities, always under their own tacit control and direction, the full benefits of the efforts of competitive electric wagon manufacturers. If this be taken up it will insure a quicker return of money, and a greater increase of business in the sale of electric energy than any other form of expenditure in the power-wagon direction.

DISCUSSION.

Mr. P. D. Wagoner, of the General Vehicle Company, said that formerly a certain central station in New England inspected vehicles which were taking current from its lines at regular intervals. Now this work is done by the manufacturer. Central-station men are not generally familiar with what has been done with electric vehicles recently. He compared the revenue from a vehicle with flatiron revenue and gave some figures on energy consumption of electric vehicles. Mr. Frank J. Stone, of the Electric Storage Battery Company, referred to the importance to a community of doing away with horses on the street to relieve congestion, dirt, etc., and unsanitary features of horse traffic. About 87,000,000 acres are devoted to the feeding of horses which could be released for other purposes. He gave the consumption of an electric truck as from 1500 to 12,000 kw-hours per annum. Mr. W. H. Blood, Jr., of Boston, complained that the manufacturers of electric vehicles have not advertised them as extensively as other kinds have been advertised. The movement to form a national electric vehicle association to be contributed to by a large number of companies is encouraging and has possibilities for great results. Mr. George H. Jones, of Chicago, said that the electric vehicle has been so thoroughly tried in Chicago as to be no experiment. He asked that manufacturers arrange batteries to be more accessible for inspection. He cited the case of one vehicle where the battery had actually run dry through lack of inspection, and in this case inspection was very difficult. He thought it was not a good plan to talk too much to users of the automatic feature of the rectifier lest they come to think that the rectifier outfit is absolutely neglect proof. Mr. Eames, being asked to define the relative fields of the gasoline and electric trucks, said that in general the gasoline vehicle was cheaper when the saving in driver's wages due to its use compensated for its increased cost of maintenance. He read a portion of a letter from the Anheuser-Busch Brewing Company to the effect that the company is not to discontinue its electric trucks, but has instead ordered more.

RESIDENCE LIGHTING

Mr. Henry J. Gille, of the Minneapolis General Electric Company, in a paper entitled "Residence Lighting," called attention to the fact that this class of business has by no means received adequate attention from central-station managers. Assuming that there are five people in a family, and that about 40,000,000 people, or 50 per cent of the population of the United States, live in cities and villages, Mr. Gille estimates that 8,000,000 families are prospective users of electricity. (It has been estimated that at present 700,000 families are supplied with electric service.) This gives a total prospective business of this nature amounting to 120,000,000 50-watt lamps, or 6,000,000 kw, not including heating devices. Based on previous investigations, this class of service is assumed to have a diversity factor of between 0.20 and 0.25, and if the average revenue per family is assumed at $20 per kw-year, the average gross revenue per kilowatt of station demand would be $80 a year, which is not far from the average gross revenue at the present time. Mr. Gille makes some suggestions as to how this business should be developed, and lays a good deal of stress on the necessity of educating customers in the proper use of illuminants, and on the desirability of obtaining artistic and harmonious effects through the proper utilization of our present knowledge of the physiological influence of color.

DISCUSSION.

Mr. V. R. Lansingh, of New York, called attention to some tests in a paper by Lansingh and Rolph before the Illuminating Engineering Society two years ago, showing that a room with dark ceiling, walls and floor requires four times more light to produce a given useful illumination than one in which ceilings, walls and floor are light in color. The color of the ceiling is most important. Mr. Geo. H. Hoffman, of Philadelphia, said that in the newer parts of Philadelphia there are few houses without electricity. In districts where houses were built 30 or 40 years ago, there is some trouble in getting the owners to wire their houses. He referred to a certain builder in Philadelphia who installed an ironing board and an electric iron in each house, and claimed he was thereby able to get $150 more rent per house. The chance of using a vacuum cleaner is now leading to the wiring of many old houses which could not be secured before.

Mr. M. C. Osborne, of Spokane, gave an analysis of residence business secured from one of his company's residence feeders. The maximum demand on the feeder per consumer was 270 watts. The average connected load per consumer was 720 watts. The average gross revenue per consumer on this feeder was $25 per year or $112 per kilowatt of maximum feeder de-

mand. This feeder supplied several hundred consumers. Incidentally he referred to a new town where the gross electric revenue has reached $8.75 per capita. Mr. E. L. Callahan, of H. M. Byllesby & Company, questioned whether the tungsten lamp would not reduce revenue in residences. He did not feel that residence lighting in itself paid. The residence peak overlaps the commercial lighting and power peak of the station. He spoke of arrangements which he had made with local contractors in a number of towns for the wiring of houses at a low cost, as described in the columns of the *Electrical World*. Mr. B. W. Mendenhall, of Salt Lake City, said that residence lighting helps to bring commercial lighting, for a man with electric service in his house is likely to come to use it in his store if he does not already do so.

Mr. Alex. Dow, of Detroit, gave figures on residence lighting which his company has gone into very extensively. It now has 21,000 residence consumers. The rate is one which would be considered low for scattered residence businesses, but which is profitable for the business as it is carried on at Detroit. The city is growing rapidly and in the last two years 9000 residence consumers have been added. The present year the number added will probably be 6000. In new residence districts the ratio of connected load to maximum district demand is 1 to 5. If there are many residences on one transformer, a transformer with a capacity of one-fifth the connected load can safely be installed. In older districts the ratio of district maximum demand to connected load is 1 to 3.5. This is because of the high cost of wiring in former days and the fact that not so many convenient lamps in closets and elsewhere were formerly installed. The monthly consumption in kw-hours for the heaviest winter months is 13 per cent of the yearly consumption, and for the lightest summer months 4 per cent. The peak load on residence districts comes one-half hour after the commercial lighting and power peak in Detroit. The diversity factor of the combined residence district demands is about 1.4 to 1.5; that is, the sum of the maximum peak demand of the different residence districts is about 1.4 times the actual maximum peak caused by these combined loads. One-half of the residence peak demand occurs at the time of maximum demand on the entire system.

Mr. Dow considers the flatiron and the fan for circulating hot air in winter as the two best revenue producers in the residence except lighting. Other devices consume so little as to amount to but little as revenue producers.

Mr. R. W. Rollins, of Hartford, told of his company's flat-rate system for low-candle power low-voltage tungsten lamps in residences. His company has connected 25,000 of these low-voltage lamps. The average rate is $1.20 per lamp per year. A compensator is installed to give low-voltage, and a flat-rate controller to prevent more lamps being installed than are contracted for. He thinks this the only system on which a company can make money with the tungsten lamp in residences. In answer to some questions he said that vacuum cleaners when desired are operated on a compensator. Flatirons are sometimes installed on a flat rate of 60 cents per month. If additional heating appliances are required a separate meter is installed and the rate is 3 cents per kw-hour. In a population of 100,000 the gross revenue is $800,000 per year.

Mr. T. I. Jones, of Brooklyn, said that the bell-ringing transformer is too expensive in operation for single residences, although for a large apartment house it is suitable. Prof. Geo. D. Shepardson referred to the "friendship factor" in residence lighting. A company doing residence lighting business comes into contact with more people than one doing commercial business only.

CENTRAL-STATION ADVERTISING.

The report of the committee on central-station advertising, Messrs. Howard K. Mohr and C. W. Lee, gives the result of a series of inquiries made of member companies, and contains a number of reproductions of newspaper advertisements. The various heads of the report are as follows: Good service; relation between solicitor and advertising; effect of advertising on the organization; results from advertising are cumulative; smaller companies obtain proportionate results; specialization in advertising; present trend of central-station advertising; advertising appropriations; some individual opinions; public policy and publicity; national advertising by electrical manufacturing companies; recent newspaper advertising by the central station. Fifty out of 80 companies reported that the newspapers form the very best medium of advertising for the central station, the next most popular method being direct-by-mail advertising. A very general use is being made of electric signs in advertising the office location of the company, and also the business of the lighting and power company at various favorable locations in cities where they operate. The maintenance of display rooms and display-window lighting has also become very general, but the use of billboards is very slight. The street-car card is only used by those companies spending large sums of money each year on advertising as a whole, or by companies operating traction lines in connection with their electric light and power business. The committee finds that companies expending large sums of money employ almost all of the well-known advertising methods, while a limited expenditure for advertising narrows itself to the newspapers, company bulletins, direct-by-mail literature and the use of various booklets, folders, inserts, etc., furnished the operating companies by manufacturers of electrical apparatus and supplies. It is stated that the yearly amount spent by different companies shows surprising variations. The committee states that an appropriation for advertising, exclusive of soliciting, could reasonably be from 1 per cent to 2 per cent of the gross revenue of the larger, and perhaps from 2 per cent to 3 per cent of the smaller companies.

DISCUSSION.

Mr. L. E. Gibbs, of Boston, said that the small company always has an advantage in that it is closer to its consumers. Advertising helps to bring the large company nearer to its consumers. Along with it all employees must be impressed with the necessity of loyalty and of putting the best foot forward. The effect of advertising may be neutralized inside of a company's office, if the enthusiasm of the advertising man is not contagious and does not permeate the entire force. In Boston a certain appropriation of kw-hours every year is made for advertising the furnishing of energy to electric signs for electric contractors. The name of the central-station company is not necessarily mentioned in such advertising. He told of the difficulties of keeping close to consumers in handling a large district with central supply, as in Boston and its suburbs. As a result of the distances between the main office and the various distributing centers, his company is about to decentralize its business organization and to establish offices in each territory which will be business centers for that territory, carrying a stock of supplies and dealing with the public directly. Mr. M. E. Bearsley, of St. Louis, told of the advertising campaign which the Union Electric Light & Power Company now has on. One of the features brought out in this is that power can be obtained by a manufacturer anywhere in the city and that he does not have to rent an old-style building with power as in former days. The company also advertises for "kicks." While many come in response to this invitation, it is believed that it is a good thing. The company advertises in a number of different daily papers.

Mr. J. C. McQuiston, publicity manager of the Westinghouse Companies, said that from figures recently compiled it appears that about 90 per cent of the population of this country is not using electric service. In small towns in the West as high as 60 or 70 per cent are using the service. In some Eastern cities the percentage is as low as 4. His companies are now furnishing advertising copy free of cost to central stations desiring it. This copy is prepared by specialists and is available to the central-station company at a much lower price than if prepared specially by each company. Mr. P. S. Dodd, publicity director of the National Electric Lamp Association, Cleveland, told how the lamp manufacturers have gone into the trade papers in various industrial lines to advertise their product. He also has had prepared campaigns of advertising for central-station

companies. In concluding this discussion, Mr. C. W. Lee urged members to use the advertising which has been prepared by manufacturing companies and which is available at a nominal cost. He had sometimes seen such advertising stored away by the cord for lack of the small amount of work necessary to circulate it.

NATIONAL ELECTRICAL ADVERTISING.

Mr. Frank B. Rae, Jr., of New York, in a paper entitled "A Plan to Interest National Advertisers in Electric Advertising" outlined the details of a campaign for educating large advertisers in the advantages of electric-sign advertising. The plan proposed consists in the writing of letters, bombarding this class with printed matter, sending a representative to discuss and explain the proposition and keeping the matter constantly agitated by means of articles published in advertising men's magazines. He said that the advertising agencies and advertisers to be solicited can be kept in a frenzy by such written and printed publications, which will consist of a letter, a post card or a designed circular every week for a year. As the prospective customers are restricted to a half-dozen large cities in the country, it will be a simple matter to have a representative make a personal call. As to articles for publication in the advertising magazines, he said that the woods are full of hack writers who can be employed at a cent a word, and the advertising magazines would jump at their offer. The advertising clubs should also receive attention. Data should also be gathered on sign location, rates, circularization, etc., for distribution to advertisers, agents and clubs. To carry out the plan will require about $5,000 for the first year, and signed subscriptions to the amount of $1,750 have, he said, already been secured.

DISCUSSION.

Mr. E. L. Callahan, of H. M. Byllesby & Company, said that the purpose of the paper was one which had his endorsement and that he believed the recommendations made therein should be carried out. He made a motion, which was duly seconded, as follows: "The plan outlined in Mr. Rae's paper has the endorsement of, and is referred by this meeting to, the newly formed Commercial Section or its officers for action." Before the motion was put to a vote, Mr. Markham, of Chicago, and Mr. Seelman, of Brooklyn, both spoke in favor of the plan. The president then called for a vote and Mr. Callahan's motion was carried unanimously.

Accounting.

PUBLIC SERVICE COMMISSION RELATIONS.

Mr. H. M. Edwards, of the New York Edison Company, chairman of the subcommittee on public service commission relations, reported that during the recent legislative season acts providing for the regulation and control of electric light companies were passed in New Jersey, Maryland, Mississippi and South Carolina. An act has been passed in Virginia providing for the taxation of franchises. It requires corporations to report their property located in the streets and highways and the value thereof.

All of the foregoing States require annual reports from the corporations and New Jersey and Maryland have authorized their commissions to establish uniform system of accounts, comparisons with other corporations, wherever located, will therefore be possible. If such comparisons are to be of any value, the accounts of reporting companies must be kept on a uniform basis. The association uniform system of accounts has met thus far every demand made upon it. The committee was appointed to bring the merits of this system to the attention of the various authorities and to urge its adoption in the event that a governmental standard is established. The committee will gladly co-operate with a member company or any of the State associations. The argument in favor of the system will be strengthened greatly if it can be shown that the companies have adopted the system of their own volition. There was no discussion of the report.

ACCOUNTING SYMBOLS.

Mr. A. L. Holme, of the New York Edison Company, in a paper entitled "Accounting Symbols," stated that with a system of accounts such as that adopted by the National Electric Light Association, it becomes apparent very soon that the use of a symbol for a name is a matter of necessity. If an expenditure represents the cost of replacing the grate bars in a steam boiler, it involves a great deal of work and loss of time to write the title of the main account, the subdivision and the section thereof on all the records kept by a company in connection with its disbursements. If the necessary information can be imparted by the use of three figures and each of the figures has its own significance a labor-saving device has been created. The decimal system possesses these characteristics and has also the advantage of flexibility and an indefinite capacity for extension.

The decimal system of accounting symbols is in use in many of the larger companies and is equally adaptable to the needs of companies requiring a minimum of analysis of their expenditures. Letters referring to a station or locality are used as prefixes or suffixes.

Employees find no difficulty in familiarizing themselves with the symbols. Outside of the accounting department employees have to do with only a few numbers. There was no discussion of the paper.

CENTRAL STATION STATISTICAL DATA.

Messrs. George A. McKana and B. F. McGuire, of the Commonwealth Edison Company, Chicago, in a paper entitled "Significance of Statistics" presented several typical examples of statistical charts and tables, prepared from actual data giving the experience of the Commonwealth Edison Company, of Chicago. One chart gives actual statistics on the cost in cents per $1 in income for four important distribution expense accounts. Cents per dollar of income takes into consideration, not only the relative increase and decrease in expense and output, but also any change in the rates of charge for output. When this method of studying costs was first worked out, probably no one in the organization realized that anything unusual regarding incandescent lamp expense had occurred. The chart showed that for two years the cost of incandescent lamps per $1 of income had increased steadily and rapidly. One of the first results of this study was an improvement in the method of handling returned lamps, resulting in a saving of about $20,000 per year. A chart showing the net increase in lighting business, the actual advertising and soliciting expense and the lighting rates in effect during the period for each of the last 14 calendar years is a complete vindication of a liberal policy regarding soliciting and advertising. The price of electricity in Chicago has been going down steadily during the years when most commodities have increased in price.

A table compiled from the billing data of all residence and small store customers in the territory surrounding the business center, a total of 50,000 in October, 1909, shows that, notwithstanding a rate reduction of 5 per cent for flats and houses, both the kw-hours and the income show a greater increase than the number of customers.

The necessity of taking the question of diversity factor into consideration in determining rates is will recognized. A study of the load factors for three classes of business analyzed in one statement establishes one reason why the retail power rate should be lower than the retail light rate and also furnishes one of the many reasons why low wholesale schedules should be established to take care of the large long-hour users. A comparison of the coal consumed per kw-hour with the total amount of energy generated shows graphically what an important factor the large central-station company has become in "the conservation of natural resources." If the energy generated at present by the Chicago company were supplied by numerous small plants, the amount of coal consumed would be at least twice as great as in 1904, or an absolute waste of nearly 1,000,000 tons per year. The significance of a classification of all the small and medium-size light customers with whom de-

mand meters are installed lies in the actual use that solicitors can make of this data. In the preparation of the valuable statistical data given in the paper the most efficient mechanical computing devices were used, such as adding machines, listing machines, multiplying and dividing machines, slide rules and electrically operated sorting and tabulating machines. Without the use of these machines the expense of working up such statistics as those given in the paper would be prohibitive.

DISCUSSION.

Mr. R. F. Pack, Toronto, said that accountants often had more knowledge concerning scientific rate-making than officers of other departments. Mr. R. S. Hale, Boston, had applied to results in that city some of the computations presented in the paper and compared the figures for the two cities. Mr. H. M. Edwards, New York, said that the paper afforded an example of the proper method of keeping track of the business.

Mr. John G. Gilchrist, Chicago, expressed the opinion that every company had some business on its books or continued some practices that would not exist if proper statistical accounting had been done. The paper referred to the saving in the return of worn-out lamps. Originally it was the practice to permit customers to send lamps to the company for renewal. From this it was but a step to the use of wagons, which served customers on call. Tests showed that many filaments were unbroken when delivered by the customers and that by the exercise of greater care and by packing the lamps like eggs many lamps could be returned to service. This would be a small item to a small company, but large to a large company. Mr. McKana, in closing, mentioned the efficiency of the computing machines and their economy in the preparation of the statistics.

CUSTOMERS' RECORDS.

Mr. R. F. Bonsall, of the Consolidated Gas, Electric Light & Power Company, Baltimore, in a paper entitled "Keeping of Customers' Records," described briefly the various steps through which a customer's record must pass. When application for service is made the employee refers to a card file to learn the conditions at that location. If a card is not found reference is had to the latest map of the lines of the company, which is placed under the glass top of the counter. If the map does not show service available he issues a request on the distribution department for an estimate on main extension and service connection. If the application is signed a card is made out, giving the permanent information respecting the customer.

Applications for service in cases where the company does not feel justified in extending the usual credit should be accompanied by a deposit covering, if on a weekly basis, at least two weeks' bills, or, if on a monthly basis, two months' bills. Orders for miscellaneous work should be taken on a material order, giving details of the work required and the terms of payment. Attached to this form is a bookkeeper's notice.

The operating department reports to the business office by 9 o'clock each morning all work completed during the previous day. It has been found good policy to allow meters to remain on the premises from three to six months after the service has been discontinued. Records show that in over 40 per cent of the cases where this plan has been tried service is resumed within that period, thereby lessening the time necessary for connection and the expense incident to removal and to installation of a meter.

The correctness of the card file of permanent information depends entirely upon the enforcement of instructions that no card shall be removed except for such a period as will permit the entry of necessary data and the return to the proper place.

DISCUSSION.

Mr. F. J. Thomas, St. Louis, said that when a card bearing important information regarding a customer was removed a receipt should be left in its place. Mr. John L. Bailey, Baltimore, called attention to the books of forms submitted in connection with the paper.

Mr. Douglass Burnett, who read the paper in the absence of Mr. Bonsall, said, in closing, that reasonable extensions may be made on the deposit by a customer of money to cover all expenses over $1 per 16-cp lamp connected. As the amounts handled by solicitors were small, surety bonds were not required for these employees.

THE COLLECTION BUREAU

In a paper entitled "The Workings of a Collection Bureau," Mr. John C. Van Duyne, of the New York Edison Company, said that in the natural development of the business it will be found necessary, sooner or later, to establish a separate department or bureau for supervising and taking the responsibility for the collection of accounts. One of the most important tributary duties of such a bureau is the scrutiny of applications for service. The New York Edison Company reached a point some years ago where the organization of a collection bureau was necessary. The bureau is a division of the accounting department, under control of the auditor. The co-ordinate bureaus are the bureau of receipts and the bureau of disbursements. The collection bureau is in charge of a chief with an assistant chief. In addition to its supervision as a whole the chief has personal charge of the wholesale accounts, which are segregated from the other accounts.

The general work of the bureau is divided into three sections, each in charge of a chief clerk. These sections are identical geographically with the layout of the contract, distribution and operating departments. The staff under each chief clerk comprises one clerk, four junior clerks and the collectors, of whom there are 14 in each of two districts and 13 in the third. In addition to the staff at the general office each district has a local branch office with a clerk in charge of collections and one assistant. The branch office clerks are limited in authority. The collectors, the chief of the bureau, the assistant chief, the chief clerks and clerks at the branch offices are under surety bonds. Books and special reports of commercial agencies, a corporation directory and the telephone directory are consulted in the formation of judgment concerning credits. References, including those to banks, are taken, although the latter have been found to be of limited value. Deposits are waived in some cases. The collection schedule for monthly accounts is arranged in accordance with geographical groups or "trips," and provides for two workings per trip per month. The plan of routing collections, assigning the entire force of collectors on a given day to the two trips falling in that day's work, is simpler in practice than the "block" plan. The latter requires periodical readjustment in territories where growth is constant. A strict adherence to the schedule followed in collection of weekly bills results in an indebtedness for approximately two weeks' energy at disconnection for non-payment. Delays may increase the possibility of loss, which is offset in some cases by deposits. Of the great mass of these accounts it is found that from the credit standpoint sufficient protection is afforded by the fact of the existence of the weekly basis.

The credit status is readjusted on accounts from time to time by the transfer of weekly customers who have a good record for a reasonable period to the monthly basis and also by refunding deposits with interest to monthly consumers. The collectors are asked to designate consumers who are entitled to these concessions. Collectors are furnished memorandum blanks on which to report complaints by consumers. Of the total collections, mail receipts comprise 70 to 72 per cent, office receipts 7 to 8 per cent, collectors 17 to 19 per cent and the disconnection routine 2 to 3 per cent.

DISCUSSION.

Mr. R. F. Pack, Toronto, asked whether the percentage of accounts collected by collectors was increasing. He had found a tendency on the part of customers to wait for collectors to call. Mr. L. A. Coleman, New York, said that a new man was liable to be thought an impostor. Collectors were not allowed to enter the bookkeeping department. Mr. E. Wheeler, Toronto,

said that appliances were demonstrated at the main office and an effort was made to get customers to pay their bills and see the appliances at the same time. Mr. John F. Gilchrist, Chicago, thought it desirable to repress the tendency toward weekly bills, which greatly increased the work in an accounting department. Solicitors were inclined to secure an increasing amount of business on the weekly basis.

Mr. H. M. Edwards, New York, said that the weekly bill customer disliked to make a deposit. Weekly bills were convenient for small tradesmen on the East Side in New York. The New York Edison Company had over 10,000 weekly customers and the business was increasing.

Mr. Van Duyne, in closing, said that the percentage of bills collected by collectors had shown only slight variations. Most collectors had been with the company for many years and it had not been found a disadvantage, in shifting them, to have them unknown to customers. In course of time they reached customers again. The contracts with weekly customers said that the bills were payable on presentation. The company considered presentation was accomplished when the bill was left with a notice that payment could be made at the nearest branch office. The cases of substitution of guarantees for bank deposits were relatively few. The percentage of bad debts was approximately ½ of 1 per cent.

STOREROOM ACCOUNTING

Mr. R. F. Pack, of the Toronto Electric Light Company, Toronto, presented a paper entitled "Storeroom Accounting," which subject was treated from the standpoint of the smaller central station. Mr. Pack quoted the *Electrical World* of May 2, 1908, as authority for the statement that 75 per cent of the central-station companies are operated in towns of less than 5000 inhabitants, and conditions to-day are no doubt similar. It is manifestly impossible for these companies to have an elaborate system of stores accounting; and since the revenues are small, it is most important that they should guard against any loss or waste. The Public Service Commissions, especially in New York and Wisconsin, have made it necessary to keep an accurate account of each improvement or addition. For this purpose the work-order system is strongly recommended, but the full benefit of this system cannot be obtained without a proper method of caring for stores and supplies. The companies will undoubtedly benefit by passing through the storehouse practically all material and supplies purchased.

It will be considered that companies are keeping a "supplies distribution ledger" or an "operating and investment ledger." Charges and credits will be made to the proper accounts in the "distribution journal" and totals taken from this journal at the end of each month will be debited to the property and plant accounts or the operating expense accounts in the general ledger, while the aggregate total will be credited to the material and supplies account in the general ledger. The only other book required by companies of the size under consideration will be a stores ledger. The storeroom should be under the control of the accounting department, as it is more difficult to keep track of material returned to the storekeeper than of any other material. The stores ledger will be a perpetual inventory and the total of the accounts therein should balance with the amount of the material and supplies account in the general ledger and should also agree with the actual amount of stock on hand. It should not, however, take the place of an annual inventory. While accounting of this class is not revenue-producing, it certainly is revenue-saving.

DISCUSSION.

Mr. W. H. Bogart, New York, spoke of the practice in New York City, where there is a storeroom in each one of four districts.

Mr. H. M. Brundage, Peekskill, said that the paper was particularly appropriate for small companies. It did not appear desirable to carry a storeroom expense account as a suspense account and distribute it at the end of a year. A better procedure would be to distribute the account each month.

Mr. E. J. Allegaert, Newark, thought that some classes of small material might be eliminated from the storeroom account with advantage. If he were the accountant for a small company he would eliminate material that could be charged to only one account, charging the cost directly to the account concerned.

Mr. H. M. Edwards, New York, said that some time ago a committee made a special investigation, especially of the storeroom methods of the Pennsylvania Railroad and as a result the New York Edison Company recast its system. The records of stores were kept in quantity by the storeroom department and in value by the accounting department.

Mr. Pack, in closing, said that his idea was that it would be less trouble for the small company to assign its charges once a year than once a month. The small parts should be kept in the storeroom account as they could be stolen or lost easily.

HANDLING CUSTOMERS' ACCOUNTS.

In a paper entitled "Care and Handling of Customers' Accounts," Mr. John M. Mulvihill, of the Denver Gas & Electric Company, declared that close students of the relations between electric companies and the public will admit that the adoption of an efficient system for the care of customers' accounts should be regarded as a vital part of a company's policy. When a contract is secured from a customer it is highly important that the name, address, rate and other provisions be written plainly. Customers dislike to have their names mispelled. It is of equal importance that proper orders be issued. Meter readers are not permitted access to ledgers under any circumstances or to have any knowledge of a previous reading. Meter readers are encouraged by bonuses to reach a standard of efficiency.

A loose-leaf ledger system will be found, aside from its utility as a record, to be the simplest, most comprehensive and practical yet devised. Bills show gross, discount and net amount. All bills are audited by a clerk who is held responsible for totals and general appearance and is encouraged by a substantial bonus. Bills are tabulated on Hollerith tabulating machines, making possible a statement, within a few hours after completion of billing, showing the total revenue separated into various headings. Statistics are compiled each month to show the number of meters set and returned, number of new contracts, number of contracts transferring accounts from one address to another and number of miscellaneous orders. Valuable information is obtained from a record of the number of bills investigated on account of low consumption.

Exceilent results are obtained by the inclusion of all electric appliance charges on the regular monthly bills. Cashiers are instructed not to accept part payment on bills without approval. With a few exceptions bills are delivered by meter readers. Perfect service may be given by the station, the new business department, the contract and other departments and be set at naught, so far as the good-will of the customer is concerned, through lack of system in the bookkeeping department.

DISCUSSION.

Mr. John C. Van Duyne, New York, liked particularly the conclusion, which laid stress on the character and personnel of the accounting department. Accuracy of the data and information supplied on contracts was very important. Mr. Douglass Burnett, Baltimore, said that the employees of the accounting department must be given proper places and conditions for work and quiet should be assured. Customers' bills should show all the necessary data. In Baltimore bills were delivered in the populous sections of the city by messengers, but were mailed to outlying districts.

Mr. E. C. Scobel, Rochester, stated that one error in a bill would nullify the efforts of other departments to cultivate cordial relations with a customer. In Rochester all customers were urged to read their own meters each day. Mr. C. E. Brenton, St. Louis, had been mailing all bills, but wanted to make a change if it could be done with economy.

Mr. Mulvihill, in closing, said that practically all rates were shown on bills. All meters were read in four days, including

those that had to be reread. Meter-readers were not allowed to keep any records of previous readings. Even the most capable readers sometimes made mistakes, not so often in reading as in writing the figures.

JOB AND WORK ORDERS

Mr. R. D. Rubright in introducing his paper on "Job or Work Order System," said that the association might obtain valuable information concerning job systems of large manufacturing concerns which convert raw material into finished products. The working-order system is likely to solve some of the difficult problems for companies which are operating in States under the jurisdiction of commissions. The Edison Electric Illuminating Company of Brooklyn received authority from the New York Public Service Commission, First District, to issue bonds recently for property. A statement was to be filed with the commission showing the monthly cost on each general class of work. By means of the working-order system compliance with the order of the commission is effected within 24 hours after the books are closed for the month. The working-order system is practical and efficient and is capable of employment by both large and small companies.

Before the commencement of a job that it is estimated will cost $100 or more, a requisition for a working order is prepared by the department under whose jurisdiction the work is to be executed. After the requisition is approved by the executive it is transmitted to the auditor and the working order issued. Sudden breaks requiring immediate repairs for continuance of service may be made at once and the cost charged directly to operating accounts without the necessity of delay for the issue of a working order. Before the working order is issued it is scrutinized by the auditing department and given a serial number and provision is made in the work-in-progress ledger for keeping account of the cost.

The most important consideration relates to the accounting for property which is withdrawn or retired from service. A form has been devised on which columns have been provided for the record of the original cost of the property at the time of installation and for the value of the good material recovered. On completion of a job of this nature an entry is made transferring the total cost, including original investment less salvage, from work-in-progress to accrued amortization of capital.

Charges for working orders emerge from four sources: Payrolls, storerooms, petty cash vouchers and invoices.

A report of the accumulated cost of each job, excluding service and short-line extension orders, is made monthly to the general superintendent and the department interested. Experience teaches that it is better to keep the departments advised periodically of what each job is costing. Particular emphasis is laid on the necessity of keeping the auditor advised concerning any job which exceeds its estimate so that whenever this happens the superintendent may be notified at once. The work-order system demands as exact an adherence to the details of the cost of jobs as that which the builder gives to plans and specifications of the architect.

DISCUSSION.

Mr. H. M. Brundage, Peekskill, spoke of the use of serial numbers as an adjunct to the scheme. It was better to give the job a specific name and then, if desired, a number in addition.

Mr. E. T. Penrose, Altoona, gave numbers to jobs and the work orders were issued under those numbers. The use of numbers saved writing the names of the jobs.

Mr. R. F. Pach, Toronto, thought that not much was gained by the use of a name in addition to a number. Mr. Rubright, in closing, referred to an instance where the cost of a job was found to be getting too high. The company was at No. 59,690 on work orders.

DETROIT EDISON SYSTEM OF ACCOUNTING.

"Accounting Methods as Applied to Detroit Electric Properties" was the subject of a paper presented by Mr. E. J. Bowers, of the Detroit Edison Company, in which was shown how it is possible to close the records of the Detroit Edison Company and compile profit and loss statements for each month by the fourth or fifth day of the following month. Each department of the accounting organization is required to have its monthly report in the hands of the general accounting department not later than the first day of the following month. The three most important items in the rapid compilation of earnings and expenses are the treatment of earnings, the treatment of expenses and the preparation of working schedules. The method used in accounting for the commercial electric earnings was described. The logical and practical way to treat electric revenue is to write the revenue upon the books from bills rendered during the month, plus estimated accrued earnings for the same month, less the reverse entry from the preceding month. Companies which treat only bills rendered as revenue, while their meter readings cover the entire month, are entirely at fault in accounting for revenue, as can be seen by a comparison of the production cost curve with the revenue curve for December and January. If the accrued earnings are not taken into consideration, the revenue written upon the books in December will represent 25 per cent of December earnings and 75 per cent of November earnings; and January earnings, since they include 75 per cent of the December bills, will be decidedly greater than the December earnings. This condition would result in an extreme fluctuation in the ratio of operating expense to gross revenue for December and January.

Accrued earnings are estimated by taking the revenue by districts and estimating the average earnings per day. This figure multiplied by the number of days from the meter reading date to the end of the month gives the approximate accrued earnings for any given district. A thorough test of this method is made by check, in the following month, of the actual earnings covered by the accrued period. Expenses were divided into four principal parts—coal, labor, vouchers and material from stores. Working papers are made up in advance, so as to permit the rapid tabulation and merger of figures from controlling and subsidiary ledgers. A comparison sheet of earnings and expenses, showing the operations of the previous month and of the corresponding month of the previous year are also made up in advance.

DISCUSSION.

Mr. John L. Bailey, Baltimore, said the paper introduced new practices in accounting and he would like to have a thorough discussion.

Mr. R. F. Pack, Toronto, thought it commendable that a statement could be prepared so early in the month.

Mr. H. M. Edwards, New York, thought that the method of determining revenue by estimate was an incorrect one. Revenue should be based on accounts rendered. The basis on which earnings were determined should be conservative to the last degree. No revenues should be written on the books but those that were, in effect, cash receivables. The discrepancy between the periods of revenue and expense each month was due to a condition of the business that could not be overcome.

Mr. C. N. Duffy, Milwaukee, said that the principle was incorrect. Books should be made to fit conditions, not conditions to fit the books. If principles were correct, the methods by which they were applied were matters of judgment, conditions and ability.

Mr. E. J. Allegaert, Newark, said that steam railroads took no account of uncollected ticket sales. Mr. F. L. Dame, New York, had been investigating properties that required financing in order to meet the needs of development in business. An investment of $4 to $7 was required for every increase of $1 in gross revenue. It was inadvisable to set up estimates of income. Mr. Bowers, in closing, said that variations had been found to be not more than 1.5 per cent.

INCOME AND SALES CLASSIFICATION

In opening his paper entitled "Classification of Income and Sales," Mr. W. W. Dow, of the Stone & Webster Corporation, said that the classification of income has received scarcely the consideration to which it is entitled. Apparently the principle that has been followed recently has been to classify expenses

to the point of absurdity, but to allow the income to care for itself. An examination was made of the classifications of income prescribed by the New York and Wisconsin Commissions, by the Interstate Commerce Commission for light and power plants operated by steam railroads, the 1908 classification of the National Electric Light Association and that in use by the Stone & Webster Companies, which conforms closely to the association standard. It shows that the revenue accounts vary in number from 9 to 18. Each classification is divided or divides itself naturally into two groups. (1) Revenues from sales of electrical energy. (2) Other revenue. The Interstate Commission entitles the first group plant revenue; the Public Service Commission of New York, sales of electric energy; the Railroad Commission of Wisconsin, operating revenue; and the association, sale of electric energy. The second group is designated variously as non-plant revenues, miscellaneous revenues and non-operating revenue.

A regular classification of sales would give better information as a basis for determining the relative profitableness of various sources of revenue and would furnish more experienced data as regards equitable rates. Having the relative load factor in view, lighting sales might be segregated into 15 accounts. The classification of income carries with it naturally the question of the form of income account. The grouping of accounts and the deductions from the gross income are handled admirably by the Railroad Commission of Wisconsin.

DISCUSSION.

Mr. F. L. Dame, New York, said that sight should not be lost of the factor of municipal lighting. Mr. Henry B. Sawyer, Boston, said that as he understood the paper, it did not suggest the abandonment of a classification that would show the revenue from municipal lighting. Mr. H. M. Edwards, New York, said that the committee on uniform accounting was necessarily restricted to very few items in the classification of income accounts. It was governed by the necessity of securing a uniform classification that should be acceptable to all companies.

REPORT OF COMMITTEE ON UNIFORM ACCOUNTING

Mr. John L. Bailey, of the Consolidated Gas, Electric Light & Power Company, Baltimore, chairman of the committee, presented the report of that body, which included a simple accounting scheme for small companies. The necessary books for the smaller or average companies should consist of a general ledger, general journal and general cash book. The auxiliary books should be a stores ledger, stores journal, invoice or voucher register and petty cash book. The general ledger is the final resting place of all of the financial and operating transactions. The purpose of the trial balance is to test the accuracy of the books. A balance sheet is a refinement of the trial balance, in which the revenue and expense items are displayed in one item, either loss or gain. When accounts in the general ledger are opened the first consideration should be convenience of reference and facility in posting and in taking off the trial balance. The general journal should be provided with special columns in such number as may be limited only by convenience. In any event columns should be supplied for eight divisions of expense. This arrangement may also be extended to the cash book or, as in many other instances, the general journal and cash book are combined and used jointly. The invoice or voucher register is the book of record of all purchases, and the medium of distribution or classification thereof. A stores ledger, used in connection with the receipt and issue of material, is so arranged that each kind of article maintained in the storeroom is allotted page or pages.

The commercial definition of statistics is "the presentation of facts in figures." Every cost which can be differentiated from other costs or every receipt of money which can be differentiated from other receipts should be a statistical basis. Comparative tables usually are of greater value to small companies than to large companies, because the larger companies are able to employ trained and experienced men who are more familiar with economical methods of operating electrical properties. Therefore, the larger companies will generally have such a fixed standard of all costs that comparison will be of less value to them than to small companies. A uniform accounting scheme, particularly for the small companies, would be of inestimable value to those who have not the opportunity for comparison which is available by larger properties.

The committee has prepared a pamphlet which includes the accounts as adopted by the association in 1908 and also the modification of those accounts, as well as the schedule of construction and equipment accounts adopted in 1909. In the introduction to this pamphlet Mr. John L. Bailey, chairman of the committee, says that the committee has not attempted to explain generally the fundamental principles of bookkeeping, but it recognizes the desire on the part of a few to become familiar with matters pertaining to correct accounting. The question under consideration is a money-saving device and the cheapening of accounts is merely incidental.

DISCUSSION.

Mr. H. M. Edwards, New York, recommended that accounting officers of small companies study and use the forms of statements contained in the report.

METER RECORDS.

Mr. Dougless Burnett, of the Consolidated Gas, Electric Light & Power Company, Baltimore, in introducing his paper entitled "Meter Records," said that no matter in the entire routine of central-station companies is of more importance than proper care of meters and meter records. It is as important to safeguard the meters and meter records as to protect the cash receipts and expenditures. Upon purchase a meter should be tagged as the property of the company, given a badge with a serial number and taken into the monthly balance. The meter should have an inspection and examination upon entering service; its performance should be investigated from time to time; it should receive all the attention necessary to maintain it in good operating condition and should finally be dismissed with honor. The methods followed by the Consolidated Gas, Electric Light & Power Company, of Baltimore, in handling meters and meter records were described. Upon the receipt of the meter from the factory a shop test is made, and the results reported on a form. A standard card form is used for the meter ledger. The stock ledger is used for controlling the stock of meters. Except for tests the meter department does work in connection with meters on the consumers' premises on order from the business office only. The city is divided into 25 meter-reading blocks so that each business day carries with it as nearly as possible an equivalent amount of work to be done each day in all departments. About four meter-reader handbooks are provided for each of the blocks, the number of customers being about 14,000 and the average number of meters per block about 700, to be read by four men. Handbooks are shifted among meter readers about every three months. It is believed to be very important to show all meter readings in kw-hours and tenths. If a meter reading showed material increase or decrease a ticket is made out giving the essential data, including average monthly consumption for a few months preceding, and an inspector investigates conditions and reports, if possible, the reason for the change. The ticket is filed with the complaint department for reference.

DISCUSSION.

Mr. Hermann Spoehrer, St. Louis, described the practice in St. Louis, where a meter reader who fails to gain access to a customer's premises slips a postal card, addressed to the company, under the door. The customer is asked to indicate the position of the dials on the postal card or to state when the meter can be seen by a meter-reader. A sample reading was shown. Mr. H. C. Schlegel, New York, said that meter-readers were shifted each month by the New York Edison Company.

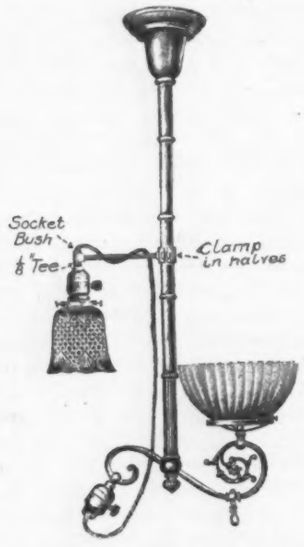
Mr. E. Wheeler, Toronto, asked how it was possible to prevent a new person from renting the premises and using the service when meters were left installed for three months after the departure of an old tenant.

Mr. Burnett said that meters when installed were always set back to zero.

LETTERS ON PRACTICAL SUBJECTS

HOME MADE ADAPTER FOR TUNGSTEN LAMPS.

Owing to the fact that the prevailing type of electric lamp fixtures have sockets set at an angle of 45 deg., the use of tungsten lamps in them is not satisfactory, as many readers doubtless know. Various types of angle sockets, adapters, etc., have been placed on the market with a view to remedying this trouble, but none of them is strictly desirable because the lamp hangs too low down and comes directly in the line of vision. It is a move in the wrong direction to bring a lamp of higher candle-power lower down on the fixture than the ordinary carbon-filament incandescent lamp, and this is just what most adapters, if not all, do. In the accompanying illustration is shown a home-made fitting which allows the lamp to hang pendant and at any desired height. The materials from which the fitting is made are readily obtainable, and the merit of the



Fitting for Tungsten Lamp.

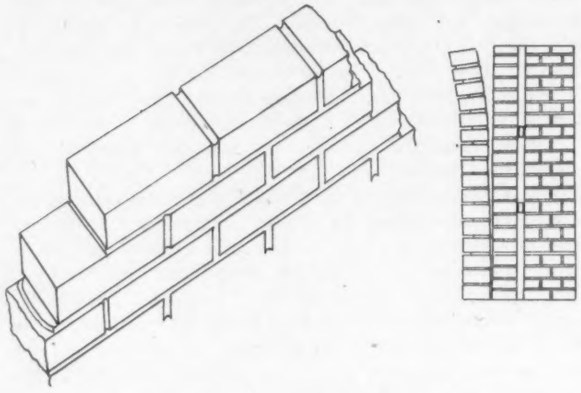
device must not be judged by its homeliness. Theoretically, at least, it possesses advantages not held by other methods which call for adapters.

San Francisco, Cal. R. H. Fenkhausen.

LINING FURNACES OF STEAM BOILERS.

A recent shutdown in a lighting station of considerable size was due to the inferior manner in which the fire-brick lining of the boiler furnaces had been put in place. Portions of the lining walls collapsed entirely, covering the fire with bricks and fragments. An examination after the fires had been drawn and the furnaces cooled down somewhat, revealed the cause of the failure to be due entirely to careless laying of the fire-bricks and to the use of too much material in the joints between the bricks. It was found that ½-in. joints were common and that in some places ¾ in. of material had been placed between the bricks. This is a very serious mistake and one which will be avoided by the careful mason who lays fire-brick linings. A first-class boiler furnace lining will have very little material between the bricks which compose the lining. In fact, instead of being laid in a bed of mortar, and tapped into place in the manner common to laying bricks in the wall, the fire-bricks should be "buttered" with thin mortar—if the material used can possibly be called "mortar"—then the bricks should be rubbed against each other horizontally, for a couple of inches, back and forth, until the surfaces of the bricks have been brought snugly together and lie "brick-to-brick" with only enough mortar material between them to fill the roughness which exists between two fire-bricks when they are laid together.

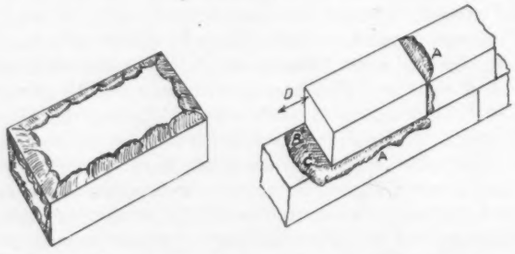
Fig. 1 shows the approved way of laying bricks in a wall, but this method is valueless for fire-brick work, and it was due to this method of laying the furnace lining that the shutdown occurred. It will be noted in Fig. 1 that there is a considerable thickness of mortar between the bricks, and, due to the disintegration of this mortar by the intense heat of the



Figs. 1 and 2—Improper Way of Laying Fire Brick and Disintegration of Thick Joints.

fire, the wall toppled over. In fact, the wall was cut down in almost exactly the manner that a woodman cuts down a tree—just by cutting into one side until the stability of the tree is destroyed and gravity topples down tree or wall, as the case may be. In Fig. 2 it is shown that the mortar disintegrated for a considerable depth, from the inner or heated wall surface, and after the disintegration had reached the center of the wall, gravity worked and the wall fell outward into the furnace.

When laying fire-brick one should never spread mortar on a course and then try to place other brick thereupon and tap them into place with trowel or hammer. That is the way in which the wall was laid which is represented by Fig. 2. The proper way of preparing a brick for laying is shown by Fig. 3; but, before putting on any mortar, the brick should be wet thoroughly. It is not enough to sprinkle the bricks; they should be wet entirely through and through, either by playing a hose on them until they cease to take in any more water, or by dipping each brick in a tub of water just before it is handed to the mason. The latter is the better way, and the tender can have a half-barrel with some water in it which he may pack with bricks and remove them as fast as they are to be handed to the mason. This means a man on the spot all the time, and it is money well spent. Fig. 3 represents a "buttered" brick. The experienced mason will take a small amount of mortar on his trowel and with two or three movements of the wrist the mortar



Figs. 3 and 4—Buttered Fire Brick and Its Application.

will be spread in a thin wedge-shaped layer all around the edge of the brick, and also on that end which is to butt against the next brick in the course. It will be noted in Fig. 3 that the mortar is not spread in the middle of the brick, and this is as it should be, for there is no need of mortar except around the very edges of the brick. With such a thin layer of mortar it is very necessary that the bricks be wet or all the moisture will be sucked out of the mortar the instant the substance is spread

upon a brick. With the brick well wetted, the mortar may be easily and quickly spread in a very thin layer all around the brick as shown by Fig. 3. Then, the brick is ready for the final operation, which is shown in Fig. 4. The brick is placed fair upon the wall a few inches from the position in which it is shown in the engraving; then, the mason bears down hard on it and rubs it back and forth a few times as indicated by the double arrow *D*. The mortar flows evenly over the surface beneath the brick and is squeezed out at the sides and ends as shown at *A, A*. The rubbing is continued until the mason knows by the "feel" of the brick that it has worked down through the thin layer of mortar until portions of the brick are in contact with the course immediately below it. Further evidence of this is usually visible in the rubbed-over portion of the lower course, where the rubbing has bared portions of the brick. This is shown at *B* and *C* where the irregularities in the lower course have become visible as they were uncovered by the rubbing.

As soon as this state of things is evident, the brick should be pushed smartly against the next brick ahead, and left in that position. One should not attempt to improve matters by hammering or tapping on the brick. Matters cannot be improved in the least by so doing, for the brick cannot go down any further after it has once "hit the high places" of the course underneath. That skill and experience are both necessary in order to perform the above-described apparently very simple operation will be evident from the very first brick the inexperienced man tries to lay. Among other little kinks which are to be acquired in this direction is the knack of having the brick come to rest exactly in the place it is to occupy in the wall. It must not be the least bit either over the face of the wall or back therefrom. It requires a little experience to acquire this knack, which is really very simple and easily acquired by anyone who will practice a little. One other thing requires attention, and that is the composition and condition of the mortar used for "buttering" the bricks. There are two methods which may be followed to advantage. The first is to obtain some fire-clay from the dealer who sold the fire-bricks, and this only needs to be wet with water and tempered as used. The other way is to save all the old firebricks—every bat and every spall should be placed in sacks or barrels until another boiler furnace is to be lined, when the pieces of fire-brick may be pounded with a hammer, maul, or a bar. Any tool will answer which breaks up the pieces of fire-brick and reduces them to a fine powder. The bricks cannot be reduced to a fine powder with a single hammering. After pounding the bats and spalls for a few minutes, they should be poured out and shaken upon a sieve or screen which has 20 meshes to the linear inch. The portion of material which passes through the sieve is ready for use as mortar for the fire-bricks, and the portion which will not pass through the sieve may be returned for further pounding.

Scranton, Pa. JAMES WILSON.

A BIT OF LINE ENGINEERING.

The construction of an intercepting sewer would not seem likely to demand some ingenious electrical engineering, but that is what actually happened very recently in South Bend, Ind., at the point where the new 6-ft. concrete sewer crosses the tracks of the Lake Shore Railroad. The 54 telegraph lines strung on the right of way of the railroad did not interfere with the sewer, but they did come seriously in the way of the cable and overhead traveler which the contractor used in excavating and filling the sewer trench. A cable about 1.5 in. in diameter was used and the span was made as great as possible and was built to handle 1.5-cu. yd. buckets. The scheme used in building this sewer was to bring the earth to a point close to one of the cable anchorages until the trench was ready for the large concrete sewer pipe. After the excavated section had been laid with pipe the earth was shoveled into the buckets again and returned to the trench whence it came. No attempt was made to excavate at one end of the trench and deposit the soil in the other end, but the "batch" method was used. At the railroad the cable could not be erected on account of the many wires, including the feeders and wires of an interurban trolley line. This item was quickly disposed of by cutting out a section of the trolley wire and elevating the feeders until the cable could work under them. The cars "rushed the gap" readily on the straight track. A single tall pole was used for elevating the feeders and then attention was given to the two lines of 27 wires each along the Lake Shore tracks. It was determined to elevate the wires sufficiently to permit the cable way to pass underneath them, and to do this a 60-ft. pole was spliced to a smaller 40-ft. pole by means of wire lashing and erected as close as possible to the line of sewer—probably 15 ft. from the line of excavation. The pole was spliced by binding the two together in two places with No. 8 iron line wire. From 14 to 20 turns were wound around both poles as closely as possible, as they lay side by side on blocking which raised them a foot or so from the ground, or just enough to allow the coil of wire to be passed under the poles. The wire was drawn taut by hand, when it was wound around the poles, and after the winding was all in place it was tightened in the following manner. A handspike was inserted in the middle of the bunch of wires and a twist given which soon took up the slack. Similar action was effected on the other side of the poles at the same time. Thus both bunches of wire were drawn taut. It proved a good deal of a job to get the handspike into the coil and take it out again at each half turn made, and as the tightening proceeded it was found almost impossible to do this on account of the wires closing down under the tension so tightly that the handspike could not be inserted again after its withdrawal from the twisted wires. To get over this difficulty, the handspikes were exchanged for a couple of steel bars, about 4 ft. long. Two pieces of 2-in. steam pipe, each 3-in. long, were procured and forced into the opening in the wire band around the poles. The pieces of pipe were inserted in the partially closed openings where the handspikes were withdrawn and this scheme worked well. The pipe permitted the insertion of the bar and, in less time than it takes to tell it, the wire convolutions were drawn so tight that the upper pole settled less than an inch when the poles were placed in an upright position.

The line on the opposite side of the track had a pole erected in a similar manner, but when this pole was loaded it was feared that the lower pole was not strong enough to carry the heavy load which would come upon it, therefore another 40-ft. pole was set into the ground as close as possible beside the short pole, to which was spliced the heavy 60-ft. pole. In fact, the set pole was entirely dug out on one side and a row of pikes was used to keep it from toppling over. As soon as the second short pole was in place the three were wound with two coils of 14 wires each, into which two more pieces of pipe were placed and then the coils were twisted as described above. There was no further doubt about this pole holding the load to be placed upon it, and the transfer of wires was proceeded with as follows:

Four men were placed on the poles adjacent to the spliced pole—two poles on each side thereof, and two men were placed on one of the spliced poles. Then, a wire—one of the upper ones—was freed from its insulator attachment on each of the four poles noted above, and by means of a line was drawn to the upper cross-arm on the spliced pole. Of course care was taken to start with the middle wire from the upper cross arm and to place it in a similar position on the high spliced pole. One by one, each of the 27 wires was freed from its insulation on the four poles and fastened to the new pole. The wires were left without support, were detached from the poles noted, and a considerable span was thus left unsupported on either side of the spliced pole. The load upon this pole was made considerable thereby, but not a sign of slip or of distress was noted in the wire splice.

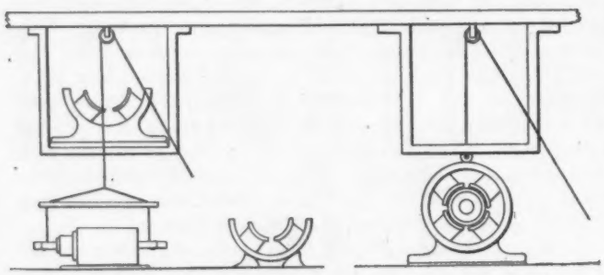
A detail of the sewer work may be of interest. The ground proved very wet along the line where the wires were raised, and the sewer line there running in the bottom of an old lake, means had to be taken to get rid of the water

which nearly filled the trench excavated for the sewer pipe. To this end, 500-volt current was brought to the spot from the street railway company's circuit and two electrically-driven pumps were installed in houses built on wagons. Holes large enough to contain these wagons were excavated about 10 ft. from the sewer trench and the pump-wagons were pushed down an inclined plane into the holes, which were as deep as could be dug without getting into the water. Sections of 4-in. pipe about 16 ft. long were tapped along their entire length every 4 ft. and a double angle valve was attached at each hole. By means of tees and nipples, suction pipes, four in number, were taken from each angle valve—two on each side thereof—and fitted with about 10 ft. of rubber suction-hose, which in turn was attached to about 12 ft. of galvanized pipe and a drive-well point of the regulation pattern. These pipes were driven about 1 ft. apart along each side of the trench. Then the triplex electrically-driven plunger pumps were put to work and almost every trace of water was removed from the earth adjacent to the trench and the work proceeded without hindrance.

South Bend, Ind. James F. Hobart.

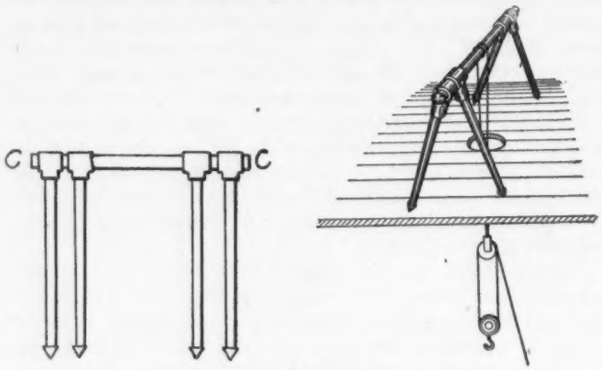
SUGGESTIONS FOR HANDLING MOTORS IN ELECTRICALLY OPERATED PLANTS.

The ideal location for a motor, especially where space is limited, is the ceiling. When a motor is thus placed it practically occupies no valuable space which would otherwise be the case providing the motor or motors were situated on the floor. For this reason the ceiling location is to be preferred and the difficulties usually met with in installing, removing or caring for motors so situated can be eliminated to a large degree. The object of the writer is to show how motors may be



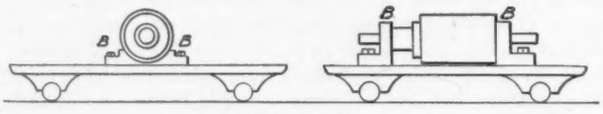
Figs. 1 and 2—Method of Lowering Motors.

handled for repairs, removal or installation involving the least amount of time and labor to accomplish the desired results. In manufacturing plants motors may vary in size from ¼ hp to 50 hp or over. The handling of the small-size motors is not difficult, since one or two men can easily attend to their various repairs, but when motors exceed 5 hp or 10 hp it is not so easy a matter to shift or change the armatures, true up the commutators or insert new bearings. In general, the boxes or suspended platforms that are attached to the ceiling, and in which the motors are placed, are small and not roomy enough to allow a sufficient number of men to work around the motor. In such a case there is only one thing to do, and that is to remove the part needing repairs from the box. Fig. 1 shows how the writer formerly removed heavy armatures from the boxes. First, the upper half of the field yoke had to be removed and then lowered to the floor to make room for the removal of the armature. After the field yoke was placed on the floor the armature was raised out of its bearings by means of a chain tackle and lowered to the floor, as shown. Then after the needed repairs were made the reverse operation had to be performed; the armature was first hoisted in the box and placed in position, then followed the field yoke, plenty of bagging or padding being employed in order to protect the armature coils and commutator from injury during the operation. This mode of removal was slow and laborious so another plan was adopted as shown in Fig. 2. With this plan an iron or wooden horse was placed centrally over the motor box on the floor above and a tackle was dropped through a hole in the floor. The motor was then raised entire from the floor of its box, the bottom of the motor box was removed, and the entire motor lowered through the opening to the floor, where the armature could be easily removed and another armature inserted. After the necessary repairs were completed the entire motor was hoisted back through the opening in the bottom and held suspended until the floor of the box could be replaced. Then the motor was lowered onto the floor and bolted in position. We found



Figs. 3 and 4—Pipe Horse and Its Application.

this plan much quicker than the old one, and as each motor was in need of repairs, we had the floor of the box fixed so that it could be removed without much difficulty and put back in the shortest possible time. The horse shown in Fig. 3 is made out of 1½-in. extra heavy steam pipe; each leg is 3 ft. in length, and the ends which rest on the floor are fitted with reducers into which are fitted lag screws with points downward, as shown. The upper ends are fitted to tees joined together with three heavy nipples having a solid bar of iron run through and capped on each end as indicated at *C*. The tees are free to move on the nipples, which enable the extension or contraction of the space between the legs at will. The lag-screw points prevent any slippage when the weight is brought to bear on the tackle. Reference to Fig. 4 will make this clear. The hole in the floor is located centrally above the motor and is countersunk to permit the cover to be flush with the floor when the hole is not being used. For conveying the motor or portion of a motor or heavy parts from one place to another a small four-wheel truck, as shown in Figs. 5 and 6, can be employed. This will be found very useful and a time-saver in carrying heavy armatures or entire motors to or from the repair shop or place of location. The blocks shown can be made fast at any point, and slots are cut in the floor of the truck for this purpose. The object in doing this is to allow the largest or smallest motor or armature to be placed on the truck, the blocks being shifted against the part which protects it from rolling or falling off during its removal. In Fig. 6 the blocks are slotted as well as adjustable for the purpose of carrying armatures. The shaft of the armature is placed in the slotted blocks, as shown, which prevents all liability to damage. Whenever an armature is placed in a lathe for repair purposes a heavy canvas strap should be placed around it



Figs. 5 and 6—Armature Trucks.

as shown in Fig. 7. A chain tackle may be hung centrally above the lathe and the armature drawn up an incline plane, which prevents it from striking against the lathe bed. The lathe centers are first tested for alignment. The armature is then lowered into position when the repairs can be made. In truing a commutator a diamond-pointed tool can be employed to advantage, and a light cut taken at each trip of the tool. By doing this there is less liability in having the tool drag the

copper and form a groove or rut, which must be cut out. After finishing with sandpaper, the armature may be taken out of the lathe and stored carefully away until needed.

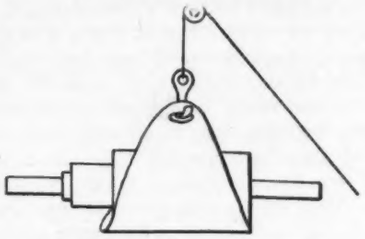


Fig. 7—Protection of Armature.

In some shops it is usual to keep two armatures of each important group of motors on hand, one running and the other in reserve. This has been found to be good policy in maintaining continuous operation of each group of machines. The moment an armature gives any trouble it can be taken out and the reserve unit inserted in its place. Formerly all motors in the factory with which the writer is connected were fitted with soft-metal bearings. These have gradually been replaced with hard-brass bearings. This substitution was a big improvement from all points of view. The bearings last from two to three times as long as the soft-metal bearings and protect the armature from injury. When a soft-metal bearing gets hot it is either crushed by the weight of the armature or the belt strain and the armature rubs or strikes against the pole-pieces injuring some of the coils or binding bands. With the hard-metal bearing there is an indication of heat before the temperature of the bearing is high enough to cause trouble. Soft-metal bearings have many faults. Since the introduction of hard-metal bearings the company has maintained its motors in a high state of efficiency and is enabled to turn out more work. Another important mode of repair for strengthening worn-out journals is to shrink over the journal a sleeve of steel tubing corresponding as closely as possible to the original size of the journal. This is preferable to removing the armature shaft and inserting a new one. It is quicker, involves less labor and is satisfactory in all respects.

New York. WM. KAVANAGH.

FAULTY STEAM PIPE ARRANGEMENTS.

In an inspection of a number of small power plants the

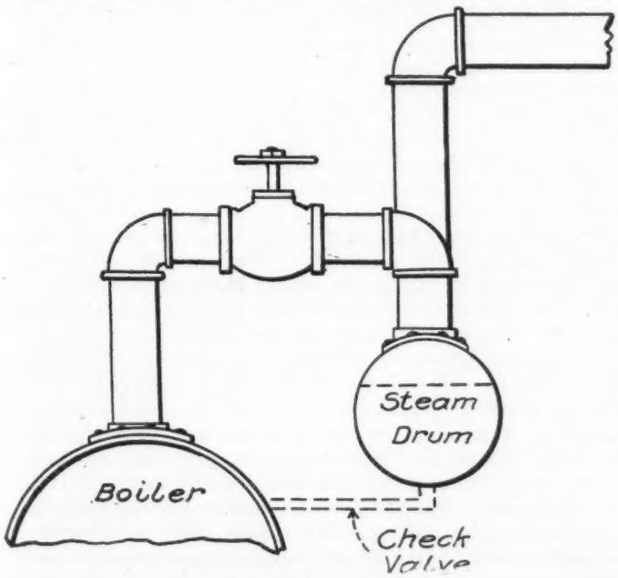


Fig. 1—Faulty Piping Arrangement.

writer was forcibly struck with the poor piping arrangements which prevail. In not a few plants the steam drums and headers are so connected as to render the operation of the boiler plant, as well as the engines, more or less unsafe and uneconomical. It would seem that it is unnecessary to direct the attention of an engineer to the danger of having pockets for the collection of water in steam mains. If the pocket is large enough the usual result is that the cylinder head is knocked off, but where the accumulation of water is not sufficient to effect this result it usually manifests itself in the cylinder valve gear. Where much water prevails the cylinder does not receive the proper amount of lubricant despite the fact that an excessive amount of oil may be fed to it. As a consequence the valve gear runs heavy and springs, and poor steam distribution results. This is due to the fact that the water washes out the lubricant before it can perform its proper function. In Fig. 1 is shown a very common but faulty steam drum arrangement which the writer noticed in a plant which he visited. The steam main leading from the boiler to the steam header entered at the top as shown. The drum carried water as indicated by the dotted line. When the engine was standing for a short time there was an accumulation of water even greater than that indicated; consequently, when the engine was started again priming resulted and the water was carried over into the

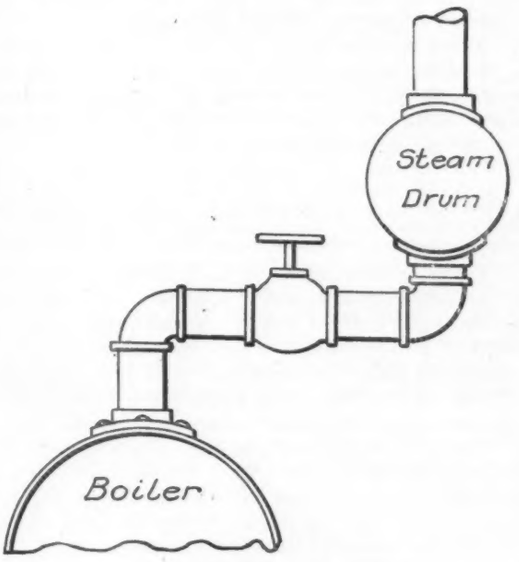


Fig. 2—Preferable Piping Arrangement.

cylinder. If the line had a water trap connected at the lowest point, this condensation would be carried off before it reached the engine. Where such arrangements exist it is possible by the installation of a good, reliable trap to keep the water from the steam drum and enable the system to work better and with greater safety. A preferable arrangement is shown in Fig. 2, where the water drains back into the boiler. It is an easy matter to install a system of this kind, and to free steam pipes from water. It is best to have a check valve in the small pipe line leading from the steam drum to the boiler, and where this scheme prevails, the header should be about 2 ft. above the water line. Otherwise the check valve will not operate because the weight of the valve would be more than the weight of the column of water, which tends to lift it from its seat. To water pockets are due most of the troubles experienced in steam plants by leakage. It is safe to assume that where leakage prevails there is a cause beyond the failure of the gasket in the line. Very frequently, also, on long mains, leaks occur near the center, and by placing a hanger on the main at this point, with a slight upward pressure, leaks will often disappear, indicating that the line was not properly supported. Leaks may also be attributed to vibration. Where vibration prevails the flanges are loosened and worn, and it is often necessary not only to replace the gasket, but to provide for this wear.

Louisville, Ky. P. T. MURPHY.

QUESTIONS AND ANSWERS

Is it possible to revive exhausted dry batteries? C. C.

If the zinc has not been eaten away, punch a hole in the top covering of the battery and pour in some water or salammoniac solution. Oftentimes the batteries are only dried out. It has also been claimed that dry batteries can be given a new lease of life by connecting them in series and charging them from a direct-current electric light circuit of proper voltage.

How greatly do variations of frequency affect meters of the induction type? Are not such meters accurate where the frequency varies a few per cent? A. H.

On lighting loads, a 10 per cent variation in frequency, which is rather abnormal and rarely exists, would introduce an error in the registration of the meter of less than ½ of 1 per cent. On motor circuits a 10 per cent variation in frequency has a more marked effect, depending on the power factor of the circuit. For power factor 0.75, the error would approximate 1.5 per cent, the tendency of the meter being to run slow on the lower frequency and to speed up on the higher frequency. In general practice the variations in frequency are such as to cause induction type meters to run slow.

It has been claimed that dead insulated wires have been charged with electricity where they pass over railroad tracks and that linemen have very often received shocks from them. Is such a thing possible? W. T.

Yes. Professor Maclean, in a paper presented before the British Institution of Electrical Engineers a few years ago, cited a case of this kind. A No. 12 insulated copper wire, one-half mile long and dead ended at each end, was found at times to be very much alive. The wire was 26 ft. from the ground and its total capacity was about 0.0087 microfarad. The remarkable phenomenon was traced to the exhaust steam from an engine. The top of the exhaust pipe was about 8 ft. lower than the wire and about 23 ft. away. On a dry day, when the wind blew the exhaust steam against the wires, a charge was communicated to them. The topmost wire being insulated was able to accumulate the charge and it acted as a Leyden jar.

How important is it to have the tubes of boilers free from soot? Does scale or soot affect economy most? E. S. M.

Few appreciate how much the economical performance of a boiler is affected through the accumulation of ashes or soot on the tubes, whether these be vertical, inclined or horizontal. Recent tests have demonstrated that when a vertical water-tube boiler was cleaned first in the ordinary way and then in a very thorough manner, the difference in the flue-gas temperature when running slightly above rating was over 100 deg. Fahr. The falling off in economy due to a thin scale inside the boiler is not very great, but the presence of scale and soot in and on tubes should be avoided. We have no data at hand on the relative effect of each, but should judge that inasmuch as soot could cover only a small portion of the tube and scale the entire inner or outer surface, the presence of the latter would have a greater effect on the economical performance of the boiler than would that of the former.

It is desired to operate a synchronous converter whose direct current side is wound for 100 volts from a 50-volt storage battery as a source of energy in order to obtain from the alternating-current side a very steady voltage suitable for testing purposes. Means are provided for bringing the converter up to speed from a separate source. Is it possible to operate the unit from the storage battery, and, if so, how can it be done? H. M. E. T.

Connect across the collector rings an auto-transformer and to the center of its winding join one terminal of the battery, the other terminal of the battery being connected to one of the brushes on the direct-current commutator. The other direct-current brush need not be used. However, the brush could be joined to one of the outer leads of a direct-current, 100-50-volt, three-wire system, the neutral lead of which is that connecting the neutral point of the transformer joined across the collector rings. The converter should be started from rest as a double-current generator and run at such speed and with such excitation as to deliver 70 volts from its collector rings to the auto-transformer and 100 volts across the commutator. The battery should then be joined between one of the direct-current brushes and the neutral point of the transformer as mentioned. After being thus connected the machine will operate continuously.

A three-phase, 60-cycle, 50-hp, 2300-volt induction motor of the squirrel-cage type is geared to a vertical triplex pump which is rated at 1000 gal. per minute when operating against a 125-ft. head. The pump and motor are located at a distance from the power house and are controlled by a starting box with a starting and running side. The box is so made that the lever must be thrown to the starting side before it can be thrown on the running side. The motor is started and run for an hour and then shut down. The meters on the switchboard show normal running. The next time the motor is started the meters do not show usual conditions when the lever is thrown to the starting side and the motor is cut off without the lever having been thrown to the running side. Upon investigation, it is found that the motor has burned out at one place on the end of the stator winding, eight or ten coils being badly charred. The solder was melted from the short-circuiting rings of the rotor and thrown onto the stator windings and from appearances one would be justified in concluding that the bars of the rotor have been red hot. The insulation in the rotor slots was also charred, but none of the line fuses were blown. The motor had only been running three weeks. What was the probable cause of the burnout and why were so few coils damaged? How could the rotor become so hot without more of the stator windings burning out? V. P.

It is probable that certain of the coils became short-circuited from some cause, whereupon they acted as a short-circuited transformer secondary to the remaining coils which formed the primary. In the short-circuited coils the current assumed a value very much greater than that in the other coils. The heating of the rotor bars was due probably to three causes; namely, proximity to the overheated stator coils, distortion in the air-gap flux by reason of the local primary transformer action, and reduction in the effective value of the flux to produce the required load torque.

It is desired to operate a 250-volt, 200-kw, two-wire generator on a three-wire system with a balancer set. There are two 100-kw, 125-volt generators which now run in parallel with a 200-kw, 125-volt machine, and we would like to run them as they are now, or operate the two 100-kw, 125-volt machines in series on a three-wire, 250-volt system, should the 200-kw, 250-volt unit break down. Should both field rheostats be used when the machines are operated in series, and would it be correct to employ the balancer set? It would be preferable to run the two 100-kw, 125-volt machines in series and in parallel with the 200-kw, 250-volt machine, if this could be done. If it can, kindly inform me how the equalizer would be connected between the two 100-kw machines and the 200-kw unit. All of the generators are compound-wound, belt-driven, direct-current machines. E. T. H.

No difficulty should be experienced in operating two compound-wound generators in series. The machines will divide the load properly according to the voltage at which each is operated. Two compound-wound machines could be connected in series and operated in parallel with a generator of double the voltage only when the compounding is not too great. In the case of the 125-volt and 250-volt machine it is probable that difficulty would be experienced on account of over-compounding. The difficulty can be overcome, however, by connecting the series coils of the two machines in series as a separate circuit, to be joined in parallel with the series coils on the 250-volt machine. The two 125-volt armatures can be similarly connected in series, and joined in parallel with the armature of the 250-volt machine. That is to say, the two series circuits of the low-voltage machines are to be operated as a single unit, and a similar treatment is to be given to the armatures. When this arrangement is employed the load current through the series coils will divide inversely in proportion to the resistances of the circuits, and it is quite probable that the resistances will bear the proper ratio.

Central Station

Management, Policies and Commercial Methods

VACUUM CLEANING BY A SMALL CENTRAL-STATION.

A small central-station company operating in a Western town of 3500 inhabitants has found vacuum cleaning a profitable side line. A portable motor-driven outfit and an attendant are furnished at a charge of 50 cents per hour where the electric service is metered and 55 cents an hour where connection is made to a flat-rate consumer. The vacuum-cleaning operations of the company, however, are not confined to its own customers, wire being carried for connecting to the pump motor in any house within 150 ft. of the company's lines. The hourly charge for the man and the machine is made to include all time from the time he leaves the office until he returns.

ELECTRICAL TRADING STAMPS.

Contractors and dealers in electric heating appliances at Hot Springs, Ark., are supplied with coupons by the local central-station company, each coupon being numbered and redeemable for $0.50 on the electric bill of purchasers of the electrical devices. Two such coupons are given with each iron, the purchaser of which is thus invited and encouraged to use, free of charge, his iron for a consumption of about 8 kw-hours at 12 cents each. The coupons are only receivable, of course, in lieu of payments exceeding the $1 minimum charge per month. Although at first the central-station company is deprived of the income from the sale of some energy consumed, it has been found that the free use of the iron made by the customer after he has discovered its convenience, later acts to make the plan a very profitable one for the electric company.

CONVICTION UNDER MISSOURI CURRENT-THEFT LAW.

The first conviction under Missouri's current-theft law, which in order for criminal action to be brought requires the complainant to prove that the defendant knowingly received the unmetered energy, was brought in at the instance of the Union Electric Light & Power Company, of St. Louis, May 20, and a fine of $50 and costs was imposed. The Missouri law is an unsatisfactory one, since in order to secure a conviction the criminal must actually be seen tampering with the meter or connections, and heretofore the mere discovery by inspectors of illegitimate taps in place has not been sufficient to bring a case upon. In the instance above mentioned, company employees saw the customer remove the jumper around his meter after having entered his saloon on the suspicion that something was wrong.

SPECIAL BILL DISCOUNTS, CREDITED ON APPLIANCE PURCHASES.

Thus far the Marianna Light & Power Company, of Marianna, Ark., has allowed no discounts on its monthly bills figured according to the contract rate. But for the double purpose of improving the promptness with which settlements are made and increasing the day load on his plant, Mr. J. M. Hewitt, general manager, is considering a scheme, original with himself, by which a 5 per cent or 10 per cent discount will be given on all bills paid within 10 days of date, this discount to be collectable, not as a cash reduction of the amount of the statement, but as a credit toward the purchase of any kind of electrical appliance whose consumption is not likely to conflict with the lighting load. The local rate for electricity is 15 cents per kw-hour, and Mr. Hewitt believes that a 500-watt iron placed in service on his lines will result in a monthly income of at least $1. In this he sees almost clear profit, after the elapse of the several months during which the amount is applied to the payment on the iron purchased.

After a "saturation point" has been reached, when his customers are stocked up with all the energy-consumption devices they can use, Mr. Hewitt proposes to install a straight cash discount. However, as motors and all kinds of heating appliances are included in the credit discount proposition, the necessity for turning to cash discounts should be at a date far distant from that at which the scheme is taken up.

CUSTOMERS' ACCOUNTS.

The methods of bookkeeping and billing in use by the Little Rock Railway & Electric Company, of Little Rock, Ark., which is one of the most progressive central-station companies in the Southwest, were described in a paper entitled "Customers' Accounts," presented by Mr. W. J. Thorp, auditor of the Little Rock company, before the Arkansas Association of Public Utility Operators' convention at Pine Bluff, Ark., April 29. The fundamental principles which underlie the handling and accounting of customers' accounts are readily divided into five topics: securing contracts, billing, reading meters, customers' ledgers, and collection of customer's accounts. A contract is required of every customer, and also a deposit, except where the party desiring service owns the property to be served. The amount of deposit required is taken equal to the estimated bill for two months.

Meters are read on every working day during the month. A few customers have their meters read, by special request, at the end of the month, and a number are read and billed weekly, the latter consisting largely, however, of moving-picture shows and theaters. The meter-reading slips are arranged in geographical order by street numbers, and, in making up the route, a great deal of thought and time is given to the arrangement in order that changes will be as few as possible, and, still more important, that they will be read on practically the same day each month. The system of loose-leaf meter-reading slips makes it possible for any change desired in routing, and also allows the insertion of meter slips for new customers and the removal or change of slips relating to discontinued services or changes in locations. The meter slip used provides for two years' entries without changing, and has space for the name and address (which is made out on the addressograph or typewriter), the account number, route number, meter number, type, size, volts, circuit designation, service, constant, index of meter, date read, reader's initials, consumption, checker's initials, and remarks. Each day's reading is kept in a book, being numbered one, two, three, etc. As soon as the reading of any particular book is completed by the meter reader it is turned into the meter department and the consumption extended. The amount of consumption is very carefully scrutinized and compared by the meter department, and where any marked differences occur in the consumption a re-read slip is immediately made out, special forms being provided for that purpose.

Immediately upon receipt of any particular bill book from the meter department, the bill clerk begins the extension of the bill. The bill book provides for the customer's address, name, mailing instructions, district, day, account number, meter number, size, type, billing instructions, installation, index of meter, date read, constant, total consumption, gross bill, trade discount, amount

of bill less trade discount, cash discount, net bill, date of bill, and remarks. As the bill sheet is a loose leaf this permits of any changes in routing, new insertions or extractions.

As soon as the calculations are made on the bill book, the next step is to make out the customer's bill, which has a coupon attached. The account number, name and address on the bill are printed by the addressograph. The bill clerk copies the index of the meter and the constant, but does not copy the consumption nor the calculations of the bill, thus giving a double check on the extension of the bills. When both the bill book and bills have been completed, each is then listed separately on the earnings sheet or journal by means of an electric adding machine.

The form used for the customers' ledgers is of the type known as the long and the short sheet book. The long sheet provides for the customer's address and name, date the service is discontinued, transferred to discontinued, customer's ledger, account number, date and amount, remarks, and details of transfer from old ledger. The sheet carries 20 accounts to the page, and five lines to each account. This sheet is designed principally to provide for the customer's name and address, the charges, credits, etc., being cared for by the short sheet. The long sheet is made of very heavy paper and the life of the ledger is practically only dependent upon the wearing out of the sheet. As the address appears first instead of the name, when a customer discontinues his service and is succeeded by another party, the same account number can be used. In case the customer discontinuing his service owed a balance at the time the successor is secured, the amount is simply transferred to the discontiued customers' ledger. When the entire page is filled and a new customer must be placed in the ledger according to the route or geographical location, an additional sheet is simply inserted, making the folio number the same, but having the line numbers read 21 to 40, etc., instead of 1 to 20.

The short sheet is simply the dollars and cents end of the ledger. It runs for a period of six months, at the end of which time it is put into a transfer binder and is replaced by a similar sheet, the only difference being in the reading of the months. This sheet is very light in weight, being so selected on account of the short time it is used in the current binder. A very novel feature of the short sheet is the turn-over end, which enables bookkeeper to carry balances forward to the next page without turning. This ledger is designed simply to show the condition of accounts; all other details, such as meter readings, constants, installations, etc., being carried in the bill book. The ledger is very easily and quickly balanced, as each sheet proves itself. A recapitulation of the totals of each sheet is obtained by a 15-bank shuttle-carriage electric adding machine.

A record is kept of each book, or set of bills, as they are mailed, and, after the 10 days allowed for cash payment has expired the bookkeeper makes up a delinquent list for that particular section. This delinquent list is made out on bills which have a coupon attached.

At the time the bill clerk runs off the regular bills on the addressograph he also runs off the delinquent notice bills, just referred to. These are filed away in cabinets, numerically, having subdivided tabs in multiples of 10 so that any bill can be readily found. The left-hand part of the bill provides for informing a customer that he will have to pay the bill within a specified time unless he desires the service discontinued; the other part of the bill can be used when it is only desired to call attention that the bill is still unpaid. Whichever stub is mailed, the other is retained in the file for the purpose of the follow-up system. These notices are then carefully followed up at the proper time.

In replying to the inquiry propounded by Mr. W. L. Wood, of Texarkana, as to how customers take to the daily reading of their meters and billing on other days than the first of the month, Mr. D. A. Hegarty, of Little Rock, called attention to the fact that his company had taken up this system of meter accounts three years ago in the face of the most critical opposition, when nearly everyone thought such a scheme would be impossible. To-day 70 per cent of the large companies employ this scheme, said Mr. Hegarty.

Mr. B. C. Fowles, of Pine Bluff, Ark., told of the precautions taken by his company to avoid "curb-stone" readings, and to get the inspector to make careful bona-fide examination of the dials he is sent out to read. To this end, the meter book is arranged so that all previous readings can be clipped, thus giving the reader no basis for an estimate without actually reading the dial. Some meters are also independently read, occasionally, as a means of checking the inspector's figures.

Mr. Thorp, the author of the paper, next went on to explain, in answer to questions, that where a customer has several meters located in different parts of town, such as office, factory, residence, etc., which are read on different days, and objects to making more than one monthly payment to the electric company, he is instructed to hold the bills first received until the last one has been rendered. Then if payment is made within 10 days of the date of the last one, the usual discount is allowed on all. Mr. Hegarty also explained that where one large consumer buying energy through a number of separate and isolated meters demands the advantage of the lower rate due to his large aggregate consumption, the entire amount is allowed to be lumped by special contract.

ROTARY CONVERTER IMPROVES STATION LOAD-FACTOR AND EFFICIENCY.

A fuel saving of 43 per cent has been recorded by the Texarkana (Tex.) Gas & Electric Light Company as the result of installing a 300-kw rotary converter to supply the local street-railway load from the lighting alternators. The machine supplanted is a 250-kw, 550-volt generator which is now held merely as an auxiliary. During daylight hours the rotary is operated from the 425-kw alternator, which, with the additional commercial demand, is thus run at nearly full load throughout the day. The other alternating-current generators completing the station equipment are one of 300-kw and one of 150-kw capacity, all the alternators being 60-cycle machines.

Under the former conditions of running separate generators throughout the day for the alternating-current lighting and the direct-current railway loads, 85 cu. ft. of natural gas was required for each kw-hour of output. With the rotary converter installed, and all generation occurring in the 425-kw machine, a specific consumption of only 48 cu. ft. per kw-hour is now reported by Mr. W. L. Wood, general manager of the company.

While this saving of over 43 per cent of the natural gas burned under the boilers of its electrical plant is not especially important to the Texarkana company, which has its own wells and is the local distributor of natural gas for domestic and manufacturing purposes (charging itself, as any other large consumer, 10 cents per 1000 cu. ft.), it is evident that the same great saving might be made in similar small combination plants where the fuel cost is a most important factor in operating expenses. In such cases, besides giving greater flexibility in allowing both loads to be handled from either generator, the installation of a rotary might work very significant economies in operating costs.

When this 60-cycle converter was installed, it was predicted that serious trouble might be expected in operation, since its capacity in such a large proportion of that of the alternator serving it, but both this objection and those arising from the inherent limitations of a 60-cycle converter have been entirely disproved in 15 months' operation. "It works like a charm," says Mr. Wood.

HOW A CENTRAL-STATION SECURED A LARGE CONTRACT.

Reference was made in these columns recently to the systematic study of motor-load development by the Narragansett Electric Lighting Company, of Providence, R. I., and an abstract of a typical report to a prospective consumer was pre-

sented. The management of this company is carrying on a combination of technical and commercial work with the most gratifying success, both in relation to old and new motor installations. One of the latest contracts to be secured was obtained after a discussion of an original report by the central station which had to be completed in three days, and in the face of an adverse report on the service and its estimated cost by the consulting engineers of the factory which was being dealt with. The engineers of the Narragansett company based their report and later discussion in rebuttal of the factory report on the usual detailed technical data obtained by taking indicator cards and making electrical measurements on the premises, combined with a thorough study of the manufacturing plant and its equipment and personal experience with steam turbine economy in all-the-year-around service. On this basis of engineering the company secured business which will probably amount to from $20,000 to $25,000 per year. An abstract of the company's report and rebuttal of the adverse report of the factory engineers is given herewith.

Steam for the present plant is generated by two Heine boilers and is used to operate an Ingersoll-Rand air compressor, capacity 350 cu. ft. per minute; a Corliss engine belted through a countershaft to a 100-kw, three-phase generator; a cross-compound Fitchburg engine, driving a 200-kw, three-phase generator by means of a rope transmission; and a Ridgway engine, direct connected to a 100-kw, three-phase generator. The air compressor has duplex steam cylinders and two-stage air cylinders, ordinarily running at full speed on 80 lb. per square inch pressure and requires about 60 ihp. The motor load in the plant is carried by the Corliss and Fitchburg engines, whose generators are run in parallel. The present average day load is 124 kw, and the electrical power-factor is so low as to tax the generators to full-load heating. The Ridgway engine-generator unit, on account of its characteristics, cannot be run with the other two units, and, therefore, is valueless except when the motor load is less than about 60 kw or the lighting load is less than 100 kw.

In the operation of the plant the chief electrician devotes considerable time to the generating department. The steam engineer is in constant attendance. One fireman does the stoking and one assistant wheels coal. Expert services are occasionally required in connection with engine tests, etc.

A new power plant to replace the one in operation had been considered by the management. Since 400 kw was required for the maximum load in winter, and since it was planned to drive the air compressor by electricity, adding 40 kw, a 500-kw turbo-generator was the smallest that could be considered. The cost of this plant, including auxiliaries, was estimated at $80 per kilowatt, or $40,000.

In figuring the operating cost of this proposed plant, interest was taken at 5 per cent; depreciation and obsolescence, 6 per cent; repairs and renewals, 2 per cent; taxes and insurance, 1 per cent; boiler evaporation, 8 lb. water per pound of coal, figured on year-around efficiency; cost of coal, $4 per ton on cars at siding outside power house; turbine steam consumption from manufacturer's guarantees, including auxiliaries; boiler-feed water, 1⅛ mills per cubic foot; labor, substantially the same as with present plant; sundries, 3 per cent on principal. Condensing water is to be taken from a pond 1000 ft. from the plant.

OPERATING ESTIMATE 500-KW TURBINE PLANT, VALUE, $40,000.

Brake hp	723	378	203
Elec. hp at switchboard	665	332	166
Kw at switchboard	500	250	125
Interest, 5 per cent	$2,000	$2,000	$2,000
Depreciation and obsolescence, 6 per cent	2,400	2,400	2,400
Taxes and insurance, 1 per cent	400	400	400
Repairs and renewals, 2 per cent	800	800	800
Sundries, 3 per cent	1,200	1,200	1,200
Coal	8,100	5,100	3,300
Water	580	360	240
Labor	5,600	4,900	4,200
Total	$21,080	$17,160	$14,540
Cost per kw-hour, cents	1.45	2.28	3.87
Energy cost 164 kw, 3,000 hours	.....	15,400	.....
Extra fuel 6 months non-condensing	.....	750	.....
Total cost motive and heat energy	.....	16,100	.....

The foregoing table gives the summarized operating cost of the plant.

The above costs of operation were figured on 2860 hours of day running and 140 hours of overtime per year. It is impossible to operate this plant at over 55 per cent power-factor.

There are at present 100 electric motors installed, aggregating 596 hp. Ten-minute readings made for two days at the switchboard showed an average load of 124 kw, and the average power-factor was 55 per cent. The motor sizes ranged from 0.75 hp to 35 hp.

The central-station plan contemplated the supply of energy at 500 volts, three-phase, 60 cycles from transformers located in a fireproof chamber built by the consumer. The secondaries were to be connected to the present switchboard, and energy was to be metered on the secondary side of the circuits. The transformer vault was to cost about $300. The basic rate for supplying electric energy was to be 10 cents per kw-hour, irrespective of the power-factor. The discounts applying to monthly bills range from 65 per cent on $600 to 75 per cent on $2,000. With central-station service no electrician's time can be charged against the cost of energy. The care of motors is not charged to energy production cost.

The cost of heating was figured at a total of $2,900, composed of depreciation, repairs and renewals, $650; coal, 400 tons, $1,600; water, $50, and labor, $600. It was assumed that the exhaust steam from the turbines would be sufficient to heat the building during the cold season. The assumption that the heating value of exhaust and live steam generated from an equal amount of coal would be the same is favoring the isolated plant. Live steam would be needed if the exhaust steam should prove inadequate. With current supplied from the central station it would be unnecessary to install additional boilers. A summary of the estimated cost of central-station service is:

Interest and depreciation on transformer vault	$ 30
492,000 kw-hours at 2.5 cents	12,300
Heating	2,900
Total	$15,230

Among the advantages of central-station service in this particular case would be the opportunity to change various features of the electric drive to secure greater economy of operation. Thus, it was deemed advisable in the study of the plant in hand to discontinue the use of eight 5-hp motors operating grinding wheels, installing one 15-hp motor for the group and thus improving the power-factor. In some cases the tools are equipped with too large motors. With central-station service the growth of the plant could be provided for with no additional investment except in motors covering the increased power required. The efficiency would remain the same regardless of the quantity of power used. The plant could also be decreased in size or operated on partial load without sacrifice of efficiency. None of these conditions would hold with an isolated plant. The large stock of motors carried by the central station makes it possible to obtain new or extra motors without delay. The possibilities of a shut-down are also less with central-station energy supply. With a 500-kw turbine, which would be lightly loaded during the daytime, conditions would be much worse for overtime production. The operation of the turbine would call for practically the same labor as during regular day service. The services of the engineering department of the central station are available at all times in co-operation with the consulting engineers of the establishment, and at no expense. The installation and operation of a turbine plant would call for a certain amount of relatively expensive superintendence by the higher officers of the factory. There will be a saving of $870 per year under present operating conditions, by purchasing central-station service. The central station was willing to take this business under a one-year contract, although it involved an expenditure of over $45,000, including the installation of

several miles of 2300-volt feeders from the power plant to the factory.

Following the central-station report upon the cost of its service in comparison with an isolated plant a separate report was made on the question by the consulting engineers of the factory. They concluded that central-station service would be more expensive than local production of energy by about $4,700 per year. The engineering division of the sales department analyzed the report, and reached the following conclusions, which, in connection with consultations by all interested parties, led to the awarding of the contract to the central-station organization. On the final figures of estimated cost the central-station engineers and the consulting engineers of the factory agreed within 0.1 cent per kw-hour.

The difference in cost as shown by the central-station report and the one prepared by the factory engineering advisers is due mainly to the different load assumed in each case. Other points to which exceptions are taken are the cost of coal for turbine operation, cost of coal for air compressor and energy used for lighting. In the report of the factory engineers it was assumed that there would be an increase of 40 kw in the average load. On the present ratio of installed horse-power to the average load this would mean the installation of about 192 hp in motors, and as the foundry and cleaning department are, up to the present time, amply provided for it would seem that this increase would be mainly in the various pipe departments of the factory. This would call for about 83 per cent more machinery. On this basis it was considered that the estimated increase of 40 kw was excessive.

The factory engineers estimated the coal consumption on the basis of an evaporation of 9.5 lb. water per pound of coal. This was based on a test where the only preparation made was blowing off the outside of the tubes. The central-station engineers considered this preparation quite material. In their own experience it has never been possible to obtain an evaporation under working conditions anywhere nearly equal to that secured during a test. A water consumption of 33.5 lb. per kw-hour is as low as could be expected at this location when consideration is taken of the various conditions under which the plant would operate, i.e., overtime and non-condensing service. This would include the water consumption of the auxiliary apparatus. The cost of coal would then be $4,500, the load being considered as on the factory estimate. The cost of coal for the air compressor would be $2,040. The number of hours in which artificial lighting would be needed was evidently taken by the factory engineers from a table based on averages compiled from city buildings and did not take into account saw-tooth skylight construction. The number of hours is also figured for 6 p. m. instead of 5:30, the latter being the closing time. An allowance of $400 for sundries by the factory appeared small when it is taken into consideration that this covers all tools used in conjunction with the entire power-generating equipment, and also all oil, waste, packing and miscellaneous supplies for one turbine and generator, one high-speed engine and generator, two exciters, three pumps, one air compressor and two boilers.

Considering the two items of coal and disregarding the three other items, i.e., increased load, lighting and sundries, that would be in favor of the central station there would be a net difference of $2,856. Using the consulting engineer's figures for energy consumption, 672,000 kw-hours, would show that the rate offered here was about 0.4 cent greater than that corresponding to the cost of operating the isolated plant. Taking into account the increased load which the consulting engineers expected, the central-station engineers remarked that it would be desirable to purchase energy rather than operate the isolated plant. The contract was awarded on a one-year basis. A feature of the situation was the arrangement by the central-station organization to supervise the installation of electric motive power in a portion of the plant which was so much separated from the main factory that the engineering staff of the latter could not handle the work at the same time with the main installation.

Wiring and Illumination

TWIN CABLE WITH GROUND WIRE.

In England there is a rule of the "Home Office" which, under certain conditions, requires all metallic fixtures to be grounded, and in order to meet this demand a special flexible cord, equipped with three conductors, has been put on the market. Two of the conductors are insulated with rubber, as is usual in twin cable, while the third conductor, or ground wire, is braided with cotton and compounded. The three conductors are then laid up circular with jute wormings, braided and served with preservative compound. In some cases the cable is provided with a flexible shield made of galvanized-wire braid, or by winding with an open spiral of galvanized-iron wire. The use of this form of flexible cord makes it easy to comply with the regulation requiring the grounding of fixtures without involving any appreciable extra work for the wireman.

AN ELECTRIC BUILDING.

The Portland Railway, Light & Power Company, of Oregon, has recently completed a building which it christened the Electric Building. It contains a large substation, the offices of the company's operating force, an electric supply store and many tenants engaged in electrical business. The illumination of the interior and exterior of this building is interesting in that it is novel and is said to be successful, both from point of economy and aesthetic and physiological effects.

The general interior illumination throughout the building is accomplished by the indirect method. The ceilings are

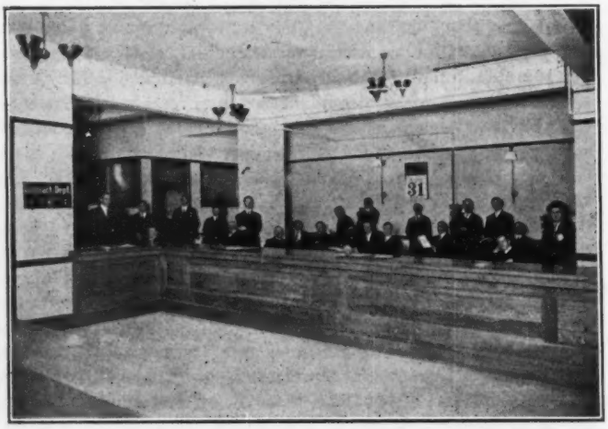


Fig. 1—Indirect Lighting of Office.

tinted a very light ivory and on the walls a light tan color is used. The fixtures, which are shown plainly in Fig. 1, are provided with opaque reflectors and direct all light toward the ceiling, from whence it is reflected to various parts of the room. Tungsten lamps are used throughout.

This method of illumination completely eliminates glare and hides from view all the light sources. The form of the reflectors is such that the light is well distributed over the ceiling, thus making the diffusing action of the ceiling more perfect. It is said that while indirect lighting as usually accomplished is expensive, that in this instance it is as cheap, if not cheaper, than the ordinary method of direct illumination. The probable reason for this is that the fixtures and the whole room, with the exception of the floor and furnishings, are designed with an exceptionally low absorption coefficient.

Indirect illumination from lamps placed around a room and comparatively near the ceiling not only involves an extrava-

gant use of energy, but also requires such a brilliant illumination of the ceiling that many persons are oppressed by the large quantity of light which enters the eyes from an unusual direction. However, with the system used in the Electric Building it is claimed that the effect is that of daylight, the diffusion being so perfect and the reflection angles so much more acute that the ceiling does not contrast so sharply with all other portions of the rooms.

For the exterior illumination a permanent decorative system of wiring has been installed. This practice should be encouraged and given more attention by central stations. All important buildings should be wired permanently for a carefully studied night effect which can be used whenever desired.

Fig. 2—Exterior Illumination.

On gala occasions great amounts of money are spent on temporary wiring for decorative lighting, and usually the effect is crude and inartistic, not to mention the expense incident to the employment of inferior labor on overtime schedule and the cost of material wasted. It costs but little more to install a permanent system, and when doing so it is possible to work out the decorative scheme so as to harmonize perfectly with the architecture of the building.

When such a system of decorative lighting is installed it will be used many times when the installation of temporary work would be out of the question. In fact, it is not improbable that it might be used quite frequently.

The Electric Building is in the vanguard of illumination progress and its example will serve to convert more people into the right way of looking at the problem. Fig. 2 shows the building illuminated.

THE LIGHTING OF THE CHICAGO POST-OFFICE.

The Chicago Section of the Illuminating Engineering Society on the evening of May 19 was the guest of Mr. William A. Richardson, electrician of the Federal Building, Chicago. The members attending were taken on a tour of inspection of the lighting features of the Government offices and Chicago post-office, which are contained in this building. Incidentally many other things of interest in the post-office mail-handling plant were inspected. After the inspection a short discussion was held in Mr. Richardson's office. Mr. Richardson mentioned especially the plan of using 9 or 10 4-cp, 11-volt sign lamps in series for the lighting of mail distributing cases, which was recently described in these columns. Rigid economy was evident everywhere in the post-office part of the building. A very moderate general illumination obtained with either mercury-vapor lamps or tungsten lamps is supplemented by lamps in opaque reflectors over the mail-distributing racks. In some cases lamps with prismatic reflectors are placed over mail-pouch racks and tables. Mr. Richardson mentioned that a lot of 4000 tungsten lamps made by a certain American manufacturer averaged 2500 hours' life in service in the building. The lamps of two other American manufacturers averaged about 400 hours.

The cleaning of lamps and reflectors, and also some of the skylights, is under charge of the electrician for the reason that he is held responsible for the cost of lighting and unless he can have charge of the cleaning the expense of lighting cannot be cut to the lowest possible figure. As Mr. Richardson remarked, when one is dealing with a 4-cp lamp it must be kept in good, clean condition. The cleaning force required in the Federal Building, exclusive of the post-office, consists of two men, one of whom, however, does not give all of his time to this work. The cleaning expense for labor is about $1,000 per year. Mr. Richardson could not give definite figures on the present amount of electric lamp glassware which is cleaned under this arrangement, but 3000 globes and reflectors were originally installed and some have been added since. The expense for electricity the first year of operating of the Federal Building was $44,000; last year it was only $26,000.

STRAP-IRON SUPPORTS FOR CONDUIT.

By George S. Mason.

In power and industrial plant wiring installations multiple conduit runs, such as that shown in Fig. 1, are frequently installed. By a multiple conduit run is meant one in which several conduits lie parallel for a considerable distance. When the course of such a run lies along a wooden wall or on wooden beams the conduit is cheaply and quickly erected. Galvanized steel pipe straps, readily obtainable anywhere, secured with wood screws turning into the wooden supporting surface, are used to hold the conduit in position. When the course of the run lies along a brick, stone or concrete surface or on structural steel members it is more difficult to erect an economical and sightly job. It is common practice, in securing conduit to a masonry surface, to drill holes in the masonry and plug the holes with either wooden wedges or soft metal expansion anchors. Wood screws turning into the plugs or anchors support the conduit carrying pipe straps. Either method, if well executed, gives fair results. But wooden wedges, although they may fit the holes tightly when inserted, are apt to become loose when the wood dries out; and the soft metal expansion anchors, particularly in the smaller sizes, do not hold well. The masonry chips out and the anchor fails.

Where but a few conduits are being installed on masonry the hole and plug method is doubtless the best and cheapest that can be used. But where several parallel conduits (a multiple run) are being put in it is neither the best nor the cheapest. It requires considerable time to drill the holes for the plugs in the masonry, and it requires some skill to locate the positions for the holes, so that the conduits will lie parallel and look well.

A method that has been successfully applied for multiple runs is illustrated in Fig. 1. Instead of drilling holes in the supporting wall and turning the wood screws supporting the pipe straps into plugs or anchors inserted in them, a strap iron bar (see Fig. 2 for a detail) is used and practically all of the drilling is done in it instead of in the wall. As indicated in the detail a bar 1½ in. x ⅜ in. makes a satisfactory support for the average condition. The length, indicated in Fig. 2 by the letter *L*, is determined by the number of conduits to be supported. Two holes, each 9/16 in. in diameter, to accommodate ½-in. lag screws, are drilled one in each end. Smaller holes are drilled, in two parallel lines, and tapped for round-head machine screws which secure the pipe straps. The size of the machine screws will vary somewhat with the size of conduit to be supported, inasmuch as the pipe straps for different sizes

of pipe have screw holes of different diameters. Where several different sizes of conduit are to be carried on the same strap-iron support it is usually possible to select one size of machine screw that will do for all the different sizes of straps.

The drilling plan, determined from the wiring diagram, is accurately laid out on one bar, and that bar is used, after the holes have been drilled in it, as a templet for drilling other similar ones. The holes are then tapped for the machine screws which support the pipe straps. Frequently in a multiple run there are more conduits at the beginning of the run than at the end. Certain conduits turn off at intermediate points. In such cases it is usually cheaper to make all of the strap-iron supports alike than to lay out new drilling plans and use supports that decrease in length as the number of conduits in the run becomes smaller. At the further end of such a run the supports, after the job is complete, will have several unoccupied screw holes for pipe straps; but, ordinarily, there is no objection to this.

It should be noted that all of the work on the strap iron support is done in the machine shop where it can be done cheaply and neatly. The wireman has only to erect the straps which requires no particular skill. The only portion of the shop work on the strap-iron supports that is at all difficult is the laying out of the holes. Obviously it is cheaper to lay them out once, under the ideal conditions of the machine shop, on the templet than many times, from a ladder, on the masonry surface. A helper can drill and tap the holes in the supports.

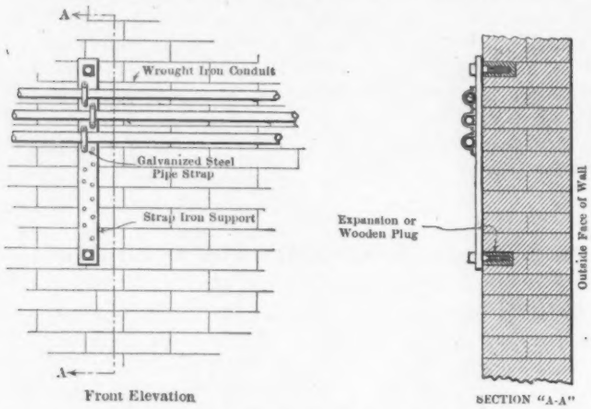


Fig. 1—Strap-Iron Support on Brick Wall.

Section "*AA*" (Fig. 1) indicates how each support is fastened to the wall. Lag screws are turned, through the two ½-in. holes, prepared for their reception, into wooden plugs or expansion anchors set in holes drilled in the wall. Expansion anchors, designed to receive ½-in. lag screws, do not give trouble by breaking out the surface of the wall and failing as do those for the small wood screws that must be used if pipe straps are affixed directly to the wall. The holes for the larger anchors are relatively deep; whereas those for the smaller ones are quite shallow. Expansion bolts, which consist of machine bolts turning into specially designed expansion anchors can be used instead of lag screws and anchors, but they are more expensive. The lag screws give entirely satisfactory results.

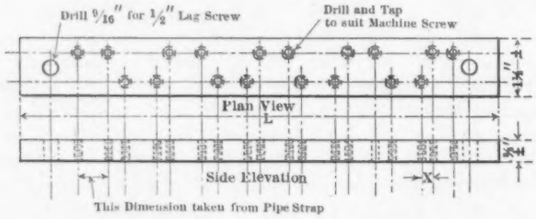

Drill 9/16" for 1/2" Lag Screw
Drill and Tap to suit Machine Screw
Plan View
Side Elevation
This Dimension taken from Pipe Strap

Fig. 2—Detail of Strap-Iron Support.

Locations for the holes, to receive the two lag screws for each support, should be accurately located vertically. This can usually be accomplished by measuring for each from the floor line of the building, or from some overhead member of which parallels the conduit run. Where brickwork is the supporting surface such measurements are unnecessary. The hole positions can be readily located by referring to the horizontal mortar joints between the bricks. The horizontal spacing of supports is determined by conditions. They should never be more than 8 ft. or 10 ft. and preferably should not be more than 6 ft. or 7 ft. apart.

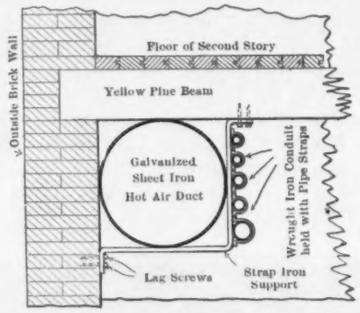

Outside Brick Wall
Floor of Second Story
Yellow Pine Beam
Galvanized Sheet Iron Hot Air Duct
Wrought Iron Conduit held with Pipe Straps
Lag Screws
Strap Iron Support

Fig. 3—Bent Strap-Iron Support.

In Fig. 3 is illustrated a special application of a strap-iron conduit support. In this case the piece of bar iron was so bent that it not only served for the support of a multiple conduit run, but it also carried a galvanized-iron, hot-air, heating duct. Although wooden floor beams, to which an attachment is easily made, were overhead, other conditions were such that it was desirable to carry the conduits either on the face of the brick wall or on an iron support. As indicated in Fig. 3 the support method was adopted, as it was the neatest and cheapest. Similar combinations can frequently be effected which will save money and add to the appearance of an installation.

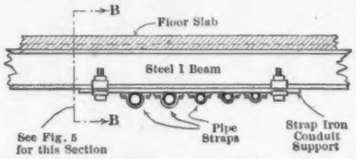


Fig. 4—Support Secured with Clamping Washer.

Where conduits are concealed in floors, walls and partitions they are always satisfactorily installed in accordance with well-known methods. In power and industrial plants much of the conduit work is exposed and it is not easy to erect the runs so that they will look well and not cost too much. When it is necessary to carry a conduit run on the lower flanges of steel-floor beams, some type of commercial "conduit I-beam clamp" is usually employed. There are several good types of these obtainable, one of which can be well employed in supporting a run of a few conduits. When a multiple run is to be supported, particularly where economy of space is essential, commercial

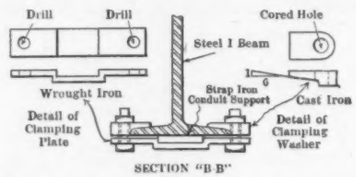


Fig. 5—Details of Clamping Washer Method.

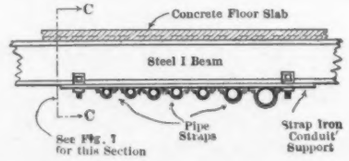


Fig. 6—Support Secured with Clamping Finger.

clamps do not satisfy. They are expensive and the job that results from their application is not always the most sightly.

Galvanized-steel pipe straps, supported directly on the I-beam flange by machine screws turning into holes drilled and tapped at considerable expense, are sometimes used instead of one of the arrangements delineated in Figs. 4, 6 and 8. The only objection to applying the pipe straps directly to the I-beam flanges is the expense that it involves. It is quite costly to locate the holes for the screws—they should be located accurately—and it is costly to drill and tap them. In Figs. 4, 6 and 8 a method is indicated wherein a strap iron support, similar to that illustrated in Fig. 2, is laid out and drilled in the shop and then

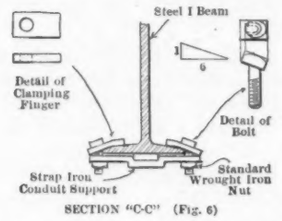


Fig. 7—Details of Clamping Finger Method.

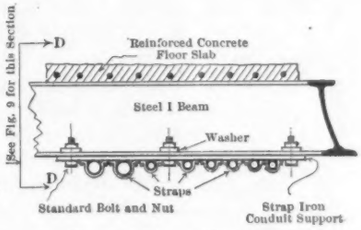


Fig. 8—Support Bolted to Beam.

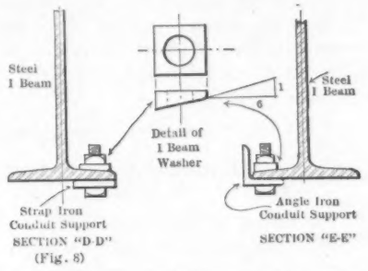


Fig. 9—Details of Method Using Bolts.

supporting bolts can be indicated on the steel drawings. They will then be punched at the steel mill, probably without any extra charge. As indicated in section *"DD,"* Fig. 9, an I-beam washer is inserted under the nut so that the faces of bolt and nut lie parallel. This is necessary. If it is omitted it will be found difficult to turn the nut and tightly clamp the support to the beam. A pattern of the type shown in Fig. 11 is convenient and economical for casting the washers. They are cast several in a strip and are broken off, one at a time, with a hammer blow. In the pattern each washer is partially separated from its neighbors by grooves cut on the two widest faces. The casting is so weakened by the grooves that it breaks readily at these points of minimum section. Instead of the I-beam washer, a sloped headed bolt (detailed in Fig. 7) can be used. It does not make as neat a job as the washer method as with it the threaded end of the bolt extends down below the nut.

Structural steel angles can be used for supports, as detailed at section *"EE,"* Fig. 9, where the load due to the weight of the conduits and the conductors they enclose, is great. By using angle sections, intermediate supporting bolts, such as the one shown in Fig. 8, can be eliminated. A detail of a steel angle support for such an application is given in Fig. 10.

clamped or bolted to the lower flange of the I-beam. Conduits are affixed to the support in the manner described in connection with Figs. 1 and 2.

In Fig. 4 the support is shown clamped to the I-beam flange with the wrought-iron clamping plate and cast-iron clamping washer detailed in Fig. 5. This method is entirely satisfactory, but has the objection that a pattern must be made for the cast-iron clamping washer. This washer is preferable to the wrought iron one shown in Fig. 7 and its use is justified if there are many supports to erect. In Fig. 6 the method shown is essentially that of Fig. 4, but no casting is required. A wrought-iron clamping finger is used which can be readily made by any blacksmith. In order that the head of the bolt

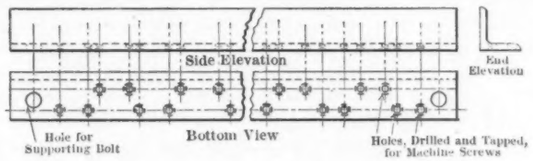


Fig. 10—Details of Angle Iron Support.

will lie normal with the upper face of the I-beam flange, it must be forged into the form detailed in Fig. 7. To make this bolt with an inclined head an ordinary machine bolt is used. It is heated to redness and inserted through a hole in a standard I-beam or channel flange so that the bolt's head rests on the inclined face of the flange. A few well-directed hammer

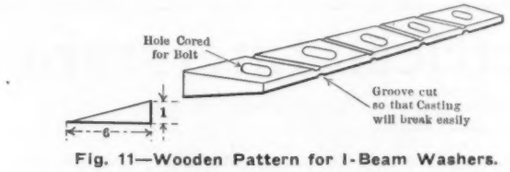


Fig. 11—Wooden Pattern for I-Beam Washers.

blows will force the head to assume the inclined form desired The slope of the lower face of the bolt's head will be 1 to 6. All flanges on standard steel sections have this slope. Instead of using the sloped headed bolt an I-beam washer (see Figs. 9 and 11 for details) and an ordinary bolt can be used, but this involves the preparation of a pattern and the delay incident to securing castings.

Commercial machine bolts are used in the method illustrated in Fig. 8 for clamping the support to the beam. This method is expensive unless the holes for the clamping bolts can be drilled with an electric or an air drill or punched at the steel mill. Where a wiring installation is being considered before the steel plans for the building have been accepted the holes for the

LETTERS TO THE EDITOR.

Meter Commutators.

To the Editor of Electrical World:

SIR:—In the March 3, 1910, issue, page 561, under the heading "Proper Methods of Meter Correction," it is stated: "If the commutator of a commutator-type meter is thoroughly cleaned and left bright the meter will probably register slow after a month's use. The reason for this is that under normal condition of the commutator the conductivity is not as high as immediately after the commutator has been polished." I believe the theory conveyed in the foregoing is new to most meter men.

An improved method to maintain the accuracy of commutator meters in service is sure to attract the attention of those in the meter work, because of the great degree of care and skill at present necessary to secure the best results with that type of meter. After reading the above article the writer selected 10 meters with the dirtiest commutators and brushes that could be found in a group of several hundred meters just as they had been removed from service. These were connected up exactly as they would be in service and allowed to run at a moderate rate of speed and the total current in the armature circuits of the 10 meters was measured; the commutators and brushes were then cleaned perfectly bright and the armature current again measured. Absolutely no difference in armature current was observed between the readings on the clean and dirty commutators. Tests on individual meters gave the same results. These tests were made with care, storage-battery current being used to secure steady voltage; a milliammeter of proper range was used to measure the armature current in order to secure a large deflection that could be accurately read; the meters were allowed to run a sufficient time before each test to allow the temperature coefficient of the potential circuit to assert itself and the room temperature was kept constant.

These tests show that the change in conductivity due to cleaning is too slight to increase perceptibly the armature current, and therefore, can have no effect on the meter accuracy. The majority of 110-volt commutator meters have a total resistance in the potential circuit of approximately 2000 ohms to 2500 ohms and the commutator resistance necessary to reduce the armature current (and the meter accuracy) 1 per cent would be 20 ohms to 25 ohms, which seems to me improbable. Many companies do not polish commutators bright, unless necessary, owing to severe sparking or difficulty in making the light load adjustment. Under favorable conditions the commutator seems to take a so-called gloss, the friction resistance of which is much more nearly constant than that of a brightened commutator. This friction resistance is purely mechanical and bears no direct relation to the electrical conductivity.

Toledo, Ohio. JOHN GILMARTIN.

Rational Central-Station Rates.

To the Editor of Electrical World:

SIR:—Business men familiar with central-station operation have doubtless read with amusement the "Back to Nature" letter of a correspondent in your issue of May 5 on central-station rates, which suggests the old adage, "Where ignorance is bliss, 'tis folly to be wise."

The writer of the letter does not state how many of his business men friends would be content to run their own business in the haphazard manner advocated by him, nor how many merchants sell their goods without first knowing the selling cost of each article. The policy of selling 50-cent ties for 19 cents to a large number of poor customers, and charging wealthy customers $8 for a $5 vest to make up the loss does not appeal to the average business man. As a result of the old uneconomic system of charging the same price for everything, the central station, because of the losses on short-hour customers, has difficulty in making a suitable rate that will look good to the large and profitable customers. Happy is the central station that can say, like the old apple woman, "I lose a cent on each apple, but I sell so many of them that it evens up in the end."

If early in the career of many of the present public-service corporations a scientific investigation of their operating costs, rates and profits had been made, many of them to-day, instead of dreading the "dividend day" and facing the clamor for municipal ownership, as appears to be the case in your correspondent's city, would be in a healthy state and have the universal goodwill of the community they serve.

Public-service corporations occupy a position unique in the business world. In return for a franchise which costs the public nothing, and which by a short-sighted policy is sold to the corporation at as high a figure as possible—the public little realizing that this reacts upon them in higher rates, or that the presence of electricity or gas in their streets and houses enhances the value of their property—the corporation is compelled (in order to make some return on the investment) to serve the smaller customers at a loss, as the maximum rate is limited, and charge the manufacturing industries, where electricity is used most economically, a higher rate. The fact that the price of manufactured products is thus increased, and that the people have to pay for it in the end, does not justify the anarachistic "don't-care-what-it-costs" policy. Carried to an extreme this policy might be applied to mercantile establishments. In return for a permit to do business in a city a shoe merchant would be compelled to sell all children's shoes at half cost, and be allowed to make his own price for adults' shoes—but the "old man" would still pay the bill.

Rational cost investigations play a large part in any of the large manufacturing industries, and why are the same not applicable to public-service corporations? Elaborate and accurate data are necessary to determine where each piece of material and each minute goes, so that the price of the finished product can be determined. Thus a manufacturer knows what part of a business is carried at a loss, and if there is no demand for the corresponding product at higher prices, this product can be dropped. It is not so with the public-service corporation. Under the terms of franchise the maximum price is limited, and the company cannot refuse to sell at this price.

The public-service corporation is at another disadvantage compared with manufacturing industries; it cannot, like the busy bee, "make honey" in the summer to carry it over the peak load of winter. As 20 per cent of the winter peak is due to the short-hour, or unprofitable customer, is there any reason why he should not carry his share of the fixed cost during the rest of the year? In a community where the small residence lighting is increasing faster than the industrial load, some rational method of caring for the large fixed charge, due to demand of the winter peak, must be devised; otherwise the company will face both the increasing loss on small customers and the inability to meet the competition of larger isolated plants.

The campaign of education, though it may seem a slow process to one so impetuous as your correspondent, will pay in the end, for the sooner the public-service corporation gains the confidence of its public the more readily will the public agree to logical rates based upon justice.

Business men of ability are necessary for the success of any enterprise, but would they approve of the policies set forth by your correspondent? Sure. Let the lawyers run the dynamos; let the blacksmiths make the watches, and let the engineers be surgeons—and, above all, let us gloriously go down to bankruptcy and municipal ownership with flags waving and a smile of contented ignorance on our lips.

Rochester, N. Y. H. C. DEFFENBAUGH.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation.—G. W. WORRALL.—The first part of an illustrated paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. In the first part of this paper, the author after discussing the theory of commutation, describes a research on the influence of contact resistance, speed, commutating e.m.f., and width of commutating pole on commutation, the phenomena being studied by means of the magnetic oscillations recorded by exploring coils on the pole shoes. The cause of the difference in behavior of the positive and negative brushes is also investigated. The theoretical considerations of the author are summarized as follows: (1) In order to neutralize or render non-existent the self-induction e.m.f. of a coil at any instant, the relative movement of the field and coil side must take place along the line of action of the resultant field at that instant. (2) Efficient commutation may be effected by a suitable adjustment of the natural period of the coil, and this may be done by properly disposing the contact resistance over the brush surface. (3) When the contact resistance is properly disposed the resistance to the forward segment is relatively high at an early stage of the commutation period. (4) Sparking at the forward tip of the brush is due to the available period being shorter than the natural period. (5) For every machine there is a critical speed at which the available and natural periods are just equal to each other, and below which the machine runs sparklessly. (6) A reduction of the natural period accelerates commutation during the early part of the short-circuit period, and increases the efficiency of commutation by lowering the maximum rate of change of the current, thereby causing a better distribution of current over the contact surface accompanied by a reduction of temperature. (7) The acceleration may be effected by a commutating e.m.f.

If the natural period exceed the available period and the commutating e.m.f. be too small, the sparking takes place at the forward tip of the brush, and if the commutating e.m.f. be gradually increased the commutation is shifted backward until sparking takes place at the rear tip of the brush. (8) The natural period of the coil when short-circuited by the positive brush is not necessarily the same as when short-circuited by the negative brush. The author then takes up the experimental results and mentions a very marked influence of commutator temperature on commutation. The negative oscillation was

Fig. 1—Commutation.

found to increase considerably with rise of temperature, while the positive oscillation diminished slightly. This was caused by a decrease in the contact resistance of the negative brush, while that of the positive brush varied but little. The theoretical conclusions concerning the disposition of the contact resistance were then tested. As mentioned above, his theory leads to the conclusion that the contact resistance of the contact surface over the rear segment should be very low compared with that over the forward segment. To attain this he cuts away a portion of the surface of an ordinary brush, as shown in Fig. 1. Only the negative brush was thus varied, as the commutation under the positive brush was already very satisfactory. The negative oscillation was gradually reduced in magnitude as the width of the forward portion of the brush surface was reduced, until the width of the latter was a minimum consistent with mechanical strength. With this shape of brush the contact surface of the brush is equally divided between the two segments when about one-quarter of the short-circuit period has expired, and just before one-half the period the contact resistance over the forward segment is confined to the narrow strip at the forward tip of the brush. With a full surface the negative brush had a tendency to spark on full load, but when the forward surface was reduced to 2.5 mm all sparking disappeared, and with a 2-mm surface the machine could be run on a 75 per cent overload without any trace of sparking. Thus the overload capacity of a machine may be greatly increased by a suitable disposition of the contact surface. This method is effective only for the negative portion, but not for the positive one.—Lond. *Electrician*, May 13.

Synchronous Converters.—A. E. SCOTT.—A paper read before the South African Institute of Electrical Engineers giving a general outline of the construction and operation of synchronous converters with reference to his experience with these machines.—*South African Inst. Elec. Eng.*, March.

Lamps and Lighting.

Inverted Arc Lamp.—An illustrated description of an inverted arc lamp of English manufacture for indirect illumi-

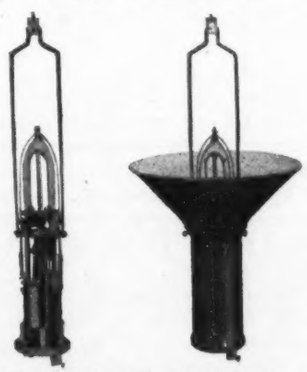


Fig. 2—Enclosed Inverted Arc Lamp.

nation. It is shown in Fig. 2, and is believed to be the only enclosed inverted arc lamp on the market. It has the advantage that there is practically no obstruction between the arc and the ceiling from which the light is reflected.—Lond. *Elec. Rev.*, May 13.

Reflecting Power of Metallic-Filament Lamps.—W. W. COBLENTZ.—Since it is difficult to show experimentally the selective emission of metallic filaments by means of emission spectra, it may be possible to get some knowledge of the spectral emissivity of the metal at high temperatures by determining its reflectivity at low temperatures. This is suggested for tantalum, tungsten and molybdenum. The author thinks that molybdenum should be more suitable than tungsten for filaments, provided certain physical defects of molybdenum can be overcome.—*Phys. Rev.*, May.

Street Lighting with Metallic-Filament Lamps.—H. HARRISON.—An account of a method of street lighting now in use in Croyden, England, by means of groups of osram lamps, each group consisting of three osram lamps of 100 cp in one lantern. These lanterns are designed to take full advantage of the upper hemispherical rays by means of a large and cor-

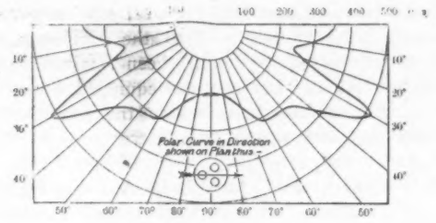


Fig. 3—Photometric Curve.

rectly shaped reflector, which directs them to a useful angle, with the result that 300 watts give over 500 cp at the most important angles for street lighting purposes. This is demonstrated by the profile curve of Fig. 3.—Lond. *Elec. Eng'ing*, May 12.

Lamp for Ultraviolet Light.—C. T. KNIPP.—An illustrated description of a convenient form of quartz-tube mercury-vapor lamp as a simple source of ultraviolet light for biological work. —*Phys. Rev.*, May.

Generation, Transmission and Distribution.

Electric Power from Waste Heat.—D. SELBY BIGGE.—An Iron and Steel Institute paper in which the author discusses the use of gas power from both coke-oven and blast-furnace gases and also the use of exhaust steam and the application of mixed-pressure turbines. In the discussion which followed T. Westgarth stated that the substitution, for the steam plant in the Barrow Hematite Steel Works, of gas engines, running with blast-furnace gas, to do the blowing for the furnaces and to produce electric energy for the works, has resulted in a saving of 1500 tons of coal per week, which he supposed was equivalent to $250,000 per annum. Another course had been adopted at South Bank, where the exhaust steam from the original steam plant was utilized for low-pressure turbo-generators. They were not driving their rolling mills and heavy machinery by electricity, however. C. H. Merz stated that exhaust-steam and mixed-pressure turbines were advocated in a number of cases where the conditions, if properly looked into, did not justify their use. There was a fashion for these turbines. It was due, he thought, to the love of the engineer for his old plant. Instead of putting in exhaust-steam turbines to improve the efficiency of the old plant, it might often be more economical to install entirely new steam plant, or gas engines, or take power from a supply company. The speaker then emphasized the importance of a good vacuum with exhaust plant and stated that very costly condensing plant was necessary to get good results. W. C. Mountain referred to actual results obtained with exhaust-steam generating plant in collieries. In one case energy was produced from the waste heat of coke ovens, and cost 0.292 cent per kw-hour. At the Kirkby Colliery, with coal at 62 cents per ton, depreciation 10 per cent and interest at 5 per cent, the total cost came to 0.652 cent per kw-hour. In a South Wales colliery, with coal at 87 cents per ton, the average cost for 12 years was 0.58 cent per kw-hour. —Lond. *Elec. Eng'ing*, May 12.

Steam Versus Electric Drive for Rolling Mills.—E. G. Sehmer and R. Drawe.—An Iron and Steel Institute paper on the economies to be effected by the use of modern reversing steam engines for the driving of rolling mills. The authors think that such an engine is more economical than an electrically driven reversing machine. This was questioned and discussed. —Lond. *Elec. Eng'ing,* May 12.

Turbo-Generators.—E. J. Brunswick.—A continuation of his long serial on turbo-generator construction. In the present installment the author deals with construction of the alternators, especially voltage regulation, construction of the rotors, and ventilation. The article is profusely illustrated by diagrams.—*L'Industrie Elec.,* May 10.

Traction.

Single-Phase Traction in Lyon.—In view of the extension of the suburban lines around the city of Lyon, in France, these have recently been transformed to the single-phase system, while the direct-current system has been retained for the center of the city. All the cars are now equipped, both for direct-current operation at 600 volts within the center of the city and for operation with single-phase energy at 6000 volts in the suburbs.—*Elek. Anz.,* May 12.

Conduit System to Be Abandoned.—A statement that it is proposed to substitute the overhead trolley system for the conduit system which is now in use in the narrow portions of the streets of Bournemouth, in England. The only reason is the heavy cost of operating of the conduit system.—Lond. *Elec. Eng'ing,* May 12.

Installations, Systems and Appliances.

Economy of Central Stations in Large German Cities.—R. Kitschelt.—An article giving a great many statistical tables based on the statistics of the Association of German Central Stations for 1908. It is shown that those large German cities which use a straight direct-current system show less economical results with respect to cost of generation and operation than three-phase or single-phase stations or combined direct-current and alternating-current stations. It is further shown that the economy of a central station increases with the amount of energy supplied for use in motors. This shows the advantages of a low rate for energy for motors; a double tariff is considered most suitable.—*Elek. Zeit.,* May 12.

Protection Against Dangerous High Voltages.—F. Schrottke.—The conclusion of his paper in which the author reports comparative experiments with the horn lightning arresters and electric valves. By means of numerous diagrams he shows that the horn lightning arresters are an effective protection of electric installations against dangerous rise of voltage, but that electric valves are not. The author's conclusion is that "protective condensers" and "electric valves" made by a certain Swiss company are unsuitable and in some cases dangerous.—*Elek. Zeit.,* May 12.

Protection of Installations Against High Voltages.—Wohlleben and Giles.—The conclusion of their paper read before the Dresden Electrical Society in which they reach conclusions directly opposite to those given in the preceding abstract. The authors claim that lightning arresters containing a spark-gap, whatever may be their construction, are fundamentally to be avoided, while electric valves are suitable.—*Elek. Zeit.,* May 12.

Wires, Wiring and Conduits.

High-Tension Cables.—M. Hoechstaedter.—An illustrated article on the dielectric properties of modern high-tension cables. From the qualities of the cables determined it seems desirable to make fuller use than heretofore of the insulating material, not only for high, but also for medium voltages, say, 3000 volts to 10,000 volts, as long as a limit is not set by mechanical considerations. For high voltages a factor of safety of five should be considered sufficient. The dielectric loss is not increased unduly thereby; it becomes of importance only above 20,000 volts. Cables for higher voltages, say, 50,000 volts, can be made and under favorable conditions there are no reasons why they should not prove reliable.—*Elek. Zeit.,* May 12.

Electrolysis of Cables.—F. Fernie.—In a continuation of the long serial on electric cables the author first considers the general phenomena of electrolysis as observed in the neighborhood of electrical networks. He then discusses in more detail the corrosion of lead-covered cables and armored cables, and the effectiveness of grounding.—Lond. *Electrician,* May 13.

Indicating Fuses.—A note on a recent British patent (19,209, 1909; May 5, 1910), granted to the British Thomson-Houston Company, Ltd. (General Electric Company, of this country). The fuse is enclosed in a fiber cartridge, and an auxiliary fine-wire fuse in parallel with the main fuse is threaded through apertures in the wall of the tube, so that a short portion lies on the outside of the tube. Over this is placed a piece of rice paper impregnated with potassium chlorate and coated with collodion to keep it dry. A label with an aperture to enable the condition of the rice paper to be seen is pasted over the whole. When the main fuse blows, the fine wire blows and burns the rice paper. A recess is made in the outer wall of the tube under the wire to provide air and prevent the conducting away of the heat.—Lond. *Elec. Eng'ing,* May 12.

Copper.—J. B. C. Kershaw.—A statistical article on copper production and prices in 1909 and the present outlook. The author thinks that it looks as though the curve of prices for the period 1895-1903 would be repeated in the period from 1903-1910. He thinks that the conditions which affect the situation all point to a rise in the price of copper during the present year.—Lond. *Elec. Rev.,* May 13.

Electrophysics and Magnetism.

The Tractive Force Between Current-Carrying Coils.—R. Czepek.—The current-carrying coils of dynamos and transformers exert on one another a mechanical force which it is often desirable to know. The author gives formulas for coils of circular, square and rectangular form and describes experiments with such coils, the numerical results being given in various tables and diagrams. Finally, some photographs of iron filings are reproduced showing the magnetic lines of flux produced with different arrangements of two coils. *Elek. und Masch.* (Vienna), May 8.

Ionization Produced by Cathode Rays.—R. D. Kleeman.—An abstract of a paper presented before the Royal Society of London on the ionization produced by cathode rays ejected by *x*-rays. The result of the author's experiments are given in the annexed table, in which are also placed the total ionizations obtained by Bragg with the alpha-particle. It will be seen that

Medium	Cathode Rays	Alpha-particle
Air	1.00	1.00
Carbon dioxide (CO_2)	1.08	1.08
Ethyl oxide ($C_4H_{10}O$)	1.23	1.32
Pentane (CH_{12})	1.31	1.35
Benzene (C_2H_6)	1.20	1.29
Ethyl chloride (C_2H_5Cl)	1.33	1.32
Chloroform ($CHCl_3$)	1.34	1.29

the two sets of values relative to air are very nearly the same. The energy spent in making an ion thus seems not to depend in any marked degree on the nature of the ionizing agent.—Lond. *Electrician,* May 13.

Reflections of Electric Waves.—L. E. Woodman and H. W. Webb.—An experimental study of the multiple reflections of short electric waves between two or more reflecting surfaces. —*Phys. Rev.,* May.

Electric Steel Furnace.—W. Borchers.—A paper read before the Iron and Steel Institute on the Girod furnace for steel refining, which he considers to be the simplest one. In the discussion which followed the superiority of the Girod furnace over the Héroult furnace was questioned by various speakers.—Lond. *Electrician,* May 13.

Units, Measurements and Instruments.

Logometer.—J. Saphores.—At the recent exhibition of the French Physical Society, in Paris, the logometer of L. Joly was exhibited which serves for measuring the ratio of two cur-

rents. The construction is shown in Fig. 4. The logometer consists of a movable part and a fixed iron core and magnet. The movable part is provided with two identical rectangular coils laid side by side in the same plane, as shown in the illustrations. In the absence of current this movable part is not subjected to any appreciable directive couple. The stationary part consists of a magnet and cylindrical iron core so designed as to get a certain distribution of the magnetic field. The cylindrical iron core is placed eccentrically with respect to the magnet pole-pieces in such a way that magnetic fluxes

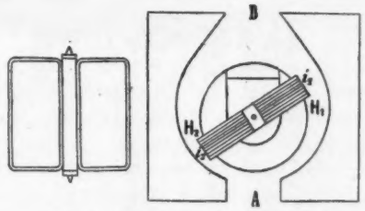


Fig. 4—Diagram of Logometer.

in the air-gap decrease from the bottom to the top. If i_1 and i_2 are the two currents directed oppositely through the two coils of the movable part, equilibrium will be established if $i_1H_1 = i_2H_2$, where H_1 and H_2 are the fluxes in the two coils. In that case the ratio of i_1 and i_2 equals the ratio of H_1 and H_2. The latter ratio may be marked once for all on a scale so that it is possible to read directly the ratio of the two currents i_1 and i_2. Since the measurement of the ratio of two resistances can be reduced to that of the ratio of the two currents when an e.m.f. is applied, the instrument may be used as an ohmmeter. The graduation of the scale depends only on the dimensions of the air-gap, so that the designer has considerable freedom. The logometer exhibited at the exposition permitted the measurement of resistances between 100 ohms and 1 megohm.—*L'Industrie Elec.*, May 10.

Alternating-Current Instrument.—An illustrated description of a periodic millivoltmeter and ammeter which can be used either for continuous or alternating current, placed on the market in England. The instrument is itself of the ordinary moving-coil permanent-magnet type, with shunts for current measurement, and resistors for voltage measurement. The moving coil is placed across two opposite corners of a Wheatstone bridge, of which the four branches are built up of thermo-elements in the manner shown in Fig. 5. The two other

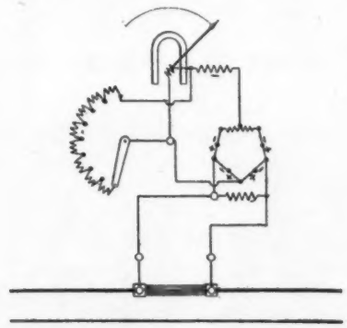


Fig. 5—Diagram of Instrument

corners of the bridge are connected to the terminals of the instrument, so that the current to be measured directly traverses the thermo-elements and thus heats them. The thermo-elements are placed in series in the two lateral branches from the connecting points to the moving coil, and they are paralleled in these points so that the moving coil is traversed by the thermo-current of two paralleled groups of thermo-elements in series. By means of suitably arranged compensating resistors the branches of the bridge are so adjusted that it is impossible for any part of the thermo-current to enter the outer leads, or for any shunted current which is to be measured to enter the thermo-elements. An adjustment for the temperature of the atmosphere is provided. This arrangement renders all the advantages of the moving-coil permanent-magnet instrument available for alternating as well as continuous currents. It is not affected by periodicity or wave form and is, of course, independent of the effects of stray fields.—Lond. *Elec. Eng'ing*, May 12.

Temperature Coefficient of the Resistivity of Nickel; Nickel Resistance Thermometer.—C. F. MARVIN.—An abstract of an American Physical Society paper. The author thinks that the use of nickel in the construction of resistance thermometers is not recognized as completely as its merits and advantages warrant. It cannot compete with platinum at high temperatures, but apparently nickel is as good, if not better than platinum at lower ranges of temperature, for instance, below 350 deg. C. The data for several samples of nickel, although admittedly scanty, show that the curve of variation of resistance with temperature is strictly logarithmic, thus $\log r = a + mt$. Hence two accurate measurements of resistance at two temperatures suffice to fix the curve. This law of resistance change is of peculiar advantage in resistance measurements with a slide-wire bridge, since readings of the slider on a scale of equal parts can be made to represent accurately temperatures over a wider range than otherwise and troublesome computations are avoided. The residuals between the observed and computed values in the data so far available do not exceed 0.1 per cent.—*Phys. Rev.*, May.

Electric Resistance Thermometer for the Measurement of Solar Radiation.—C. F. MARTIN.—An abstract of an American Physical Society paper. Pouillet's actinometer, although greatly improved by a long list of physicists, has, as yet, failed to give a satisfactory absolute measurement of solar radiation. This is mostly because mercurial thermometers are employed. The problem is a problem in calorimetry. The use of electrical resistance thermometers removes serious difficulties almost completely, as, for example, bad heat conductivity and losses along the thermometer stem, heterogeneous material of different specific heats, and the uncertain relation between temperature change shown by thermometer and true change in temperature of calorimeter. A calorimeter, or "block," for absorbing solar radiation can be constructed of thin metallic ribbon which is at once a thermometric bulb and a calorimeter. Its specific heat is measured with great accuracy in situ by sending through the ribbon measured electric currents and observing the heating effects. The details of a pyrheliometer constructed on this plan with accessory apparatus were shown by lantern slides.—*Phys. Rev.*, May.

Exhibition of Instruments.—J. SAPHORES.—An account of the various industrial electrical measuring instruments, laboratory instruments, and other devices exhibited at the recent annual exposition of the French Physical Society in Paris.—*L'Industrie Elec.*, May 10.

Telegraphy, Telephony and Signals.

High-Freqency Currents for Telegraphy and Telephony.—DEVEAUX-CHARBONNEL.—Wireless telephony has attracted attention to the use of alternating currents of high frequency in the circuit of a microphone. This has inspired the idea of proceeding in a similar manner in ordinary telegraphy and telephony, particularly for submarine communication. By using the ordinary formulas it would seem that the attenuation and the speed of propagation tend to become independent of the frequency at high frequencies, so that periodic currents of sufficiently high frequency would then be propagated without any distortion. But on the basis of an analysis by K. Wagner the author shows that such a conclusion would be wrong.—*La Lumière Elec.*, May 7.

Telephone Transmitter.—A note on a recent British patent of F. Gottschalk (17,368, 1909; May 5, 1910). The effect of the sound waves on the diaphragm is intensified by focussing them at the center. This is accomplished by attaching a cup-shaped device to the center of the diaphragm, the concave surface facing the aperture in the mouthpiece. The cup also protects the diaphragm from dust and moisture. A microphone contact, consisting of a small asbestos chamber with partitions

filled with carbon granules, is also described.—Lond. *Elec. Eng'ing*, May 12.

Telephone Relay.—S. G. Brown.—An account of the discussion which followed Brown's paper on his new telephone relay, recently abstracted in the Digest. Cohen and Eccles suggested that the main point in the explanation of the relay was that the resistance of the thin film of oil at the contact altered with variations of the thickness. It was questioned whether the Brown relay had been in use sufficiently long to give any idea as to its stability in continuous working conditions. Reference was also made to the Shreeve repeater in use in this country.—Lond. *Electrician*, May 13.

Telephone Relay.—A note on a recent British patent of C. Stille (65, 1910; May 5, 1910). Two coils wound in opposite directions and connected in series are placed side by side in a strong magnetic field, the axis of the coils being at right angles to the direction of the field. A stationary iron core is inserted in the coils to increase the flux. The two coils are pivoted or suspended and are kept in position by a spring or torsional wire. Attached to each coil is a carbon block, and between the two blocks are carbon balls forming a michophonic contact. Weak telephone or other currents in the coils cause them to move in opposite directions and vary the pressure on the microphone contact. This variation in pressure reproduces the original current waves in the secondary circuit containing this microphone contact.—Lond. *Elec. Eng'ing*, May 12.

Miscellaneous.

Resuscitation.—Louise G. Robinovitch.—An article on a new method of resuscitation of subjects in a condition of apparent death caused by chloroform, ether, electrocution, drowning, etc., emphasizing the necessity of excluding the central nervous system from the circuit during the rhythmic excitations, and describing the clinical application of the method. In her method she uses "various electric currents that produce respiratory movements of required amplitude accompanied by cardiac beats; the latter are feeble at first, but their force is gradually increased with the good progress of the respiration, and when spontaneous respiration is sufficiently established the spontaneous heart beats also increase in amplitude and the application of the electric currents may then be withdrawn." For emergency in power houses or in any place where an accidental electrocution may take place, she has constructed a special coil that gives a sufficiently strong current for practicing rhythmic excitation.—*Jour. of Mental Pathology*, Vol. VIII, No. 4.

Book Review.

Electric Power Plants. A Description of a Number of Power Stations. By Thomas Edward Murray. New York. 348 pages, 152 illustrations.

The author, who is general manager of the New York Edison Company, has designed a considerable number of important power plants, some of which are unique in the completeness of their provisions against interruption of service. Plants typical of different classes of service have been selected by Mr. Murray from those of his own design and are described and well illustrated in the present book.

There is no attempt in the book to treat the general problem of central-station design, nor to give the theory involved. The plans are taken as finally designed and the equipment described in detail and illustrated by excellent reproductions of photographs and line drawings. The author is to be commended for putting at the disposal of the engineering profession such a complete record of modern central-station design to which engineers may turn for precedent in working out their designs. The book is printed on coated paper, bound in cloth and well indexed.

New Apparatus and Appliances

TELEPHONE SELECTOR.

For a year or more engineers of the Western Electric Company have been working in conjunction with prominent railway people on the development of a selector which, with its standard grade of telephone apparatus, would enable a complete Western Electric installation to be offered to railroads interested in the use of the telephone for train dispatching or message work. The final model of the Western Electric selector was made several months ago, and since then a complete installation has been undergoing service test on one of the busiest railroad divisions in the United States. The trial installation, it is stated, proved even more successful in its operation.

Telephone Selector.

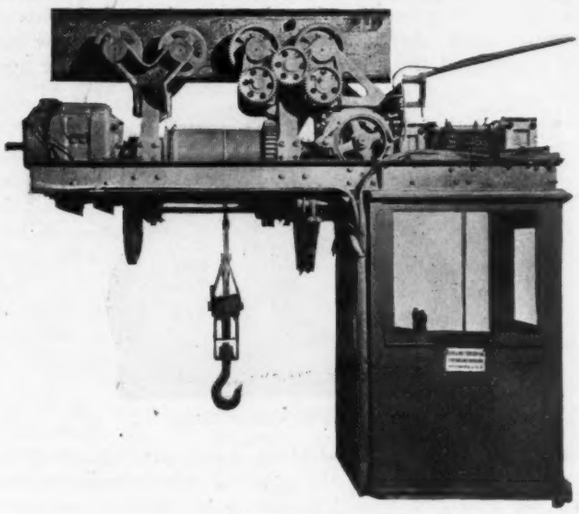
The new selector is a very simple device, being a straight step-by-step mechanism with but three moving parts, bridged directly across the line. There is only one contact made, and as all relays and other complicated parts are eliminated, it is claimed that the selector is as near perfect as it is possible to make it. Central-battery ringing is provided for, thus doing away with the necessity of installing dry batteries at the way stations. The selector is also arranged for local-battery ringing if desired. The new selector is illustrated by the accompanying cut.

NEW DESIGN OF MONORAIL TROLLEY.

Heyl & Patterson, Inc., of Pittsburgh, Pa., have recently installed a new monorail trolley at the plant of the A. M. Byers Company, Girard, Ohio, the trolley distributing coal to the boxes back of the puddling furnaces, from which it also takes the ash and cinder. It carries a 2-ton bucket, the hoisting speed of which is 50 ft. per minute; the trolley has a transverse speed of 350 ft. per minute.

The trolley frame is hung from two cast-steel trucks by means of two straps (steel forgings) resting on single ball bearings. This construction makes the trucks independent of each other and permits the trolley to round a curve with as small a radius as 11 ft. Each truck has four 10-in. cast-steel track wheels, and all four wheels of one truck are driven by a 7½-hp Westinghouse motor connected through a spur gear reduction to the countershaft, which drives each wheel through a bevel gear reduction. A band brake, which is operated by a foot treadle in the cab, is provided on the motor armature shaft to control the travel. It is to be especially noted that the travel wheels are set at such an angle as to be perpendicular to the slope of the flange of the 15-in. I-beam on which they run, which, of course, reduces the wear on the wheels and the beam.

The bucket-operating machinery consists of an 11-hp Westinghouse motor connected through a spur-gear reduction to a 12-in. drum. A band brake is provided on the countershaft to control



Monorail Trolley.

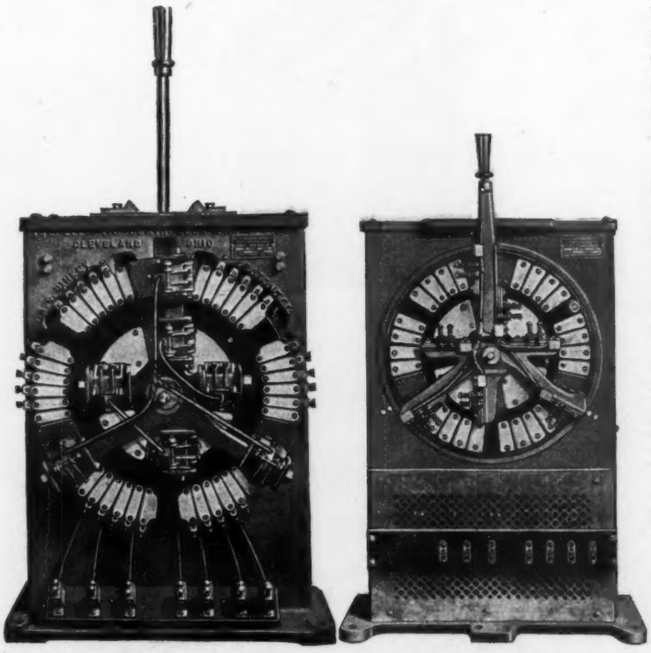
the lowering speed and to hold the bucket stationary when the power circuit is open.

Both the traverse and hoist motors are operated by means of rheostatic controllers.

ALTERNATING-CURRENT CONTROLLERS.

The flexibility and ease with which alternating current may be transmitted has, within the past few years, resulted in a large and increasing use of alternating-current motors for operating cranes and mill machinery.

For this character of work the series-wound direct-current motor has the very desirable characteristics of high starting



Figs. 1 and 2—Alternating-Current Controllers.

torque. In alternating-current motors the high starting torque feature is more favorable in the slip-ring type of motor than in the squirrel-cage type, speed and torque control being obtained by inserting and varying resistance in the secondary windings of the motor.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has developed a line of manually operated controllers for slip-ring alternating-current motors from 1 hp to 100 hp. These controllers follow as closely as possible in design and construction the direct-current controllers made by this company, wearing parts on the alternating-current and direct-current controllers being to a large extent interchangeable.

The controllers illustrated are for use in connection with reversing slip-ring motors, either two-phase or three-phase. The resistor is entirely self-contained, it being necessary to connect only seven leads to the controller. Where heavy currents are to be handled, cast grid resistors are employed, and special precautions have been taken to insure insulation which will be permanently satisfactory.

Fig. 3—Alternating-Current Controller.

All contacts are mounted on a vertical slate face so that mill dust cannot settle between segments, causing short-circuits. All contacts are of heavy copper and are reversible. The use of screws or bolts with special threads has been avoided, and so far as possible, wearing parts have been designed so that they can be manufactured by the user in his own repair shop.

The operation of all of these controllers is by a lever motion which the manufacturers consider advantageous for crane and mill service. Although the cuts illustrate controllers for slip-ring motors, the company also builds controllers for squirrel-cage motors and alternating-current commutating motors.

THREE-PHASE TRANSFORMERS.

Three-phase transformers offer advantages over the combination of three single-phase transformers, which are becoming more generally recognized in this country. As compared with three single-phase transformers connected into a three-phase system, the three-phase transformer has the following advantages: Lower cost, lighter weight, higher efficiency, less space, simpler wiring and automatic balancing of the phases.

The low cost results from less material, and in reality a single three-phase transformer costs about 20 per cent less than three single-phase transformers to do the same work.

Due to the less weight and also to the fact that it is concentrated in one unit, it costs less to ship and erect a three-phase transformer than the equivalent rating in three single-phase transformers.

For circuits carrying motor and lighting loads the three-phase transformer has the advantage of automatically balancing the voltage due to the interconnection of the magnetic circuits.

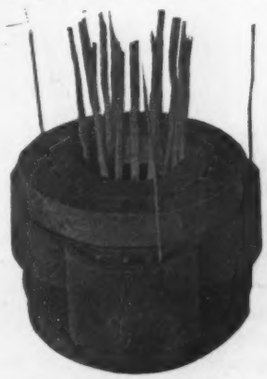


Fig. 1—Coils and Core of Transformer.

The Kuhlman Electric Company, of Elkhart, Ind., builds a line of three-phase transformers which may be classed as of the mixed core and shell type. The construction of the magnetic and electric circuits is shown in Fig. 1. It is claimed that this is the only transformer employing this type of core now built in the United States. The core is built of non-aging silicon

steel. The primary coils are star-connected and the secondary coils are delta connected. Oil ducts are provided throughout the core and between the coils so that at full load for 10 hours

Figs. 2 and 3—Three-Phase Transformers.

the temperature only rises 45 deg. C. If full load is carried for 20 hours it will reach 50 deg. C.

Fig. 2 shows a 5-kw transformer built in sizes up to 50 kw; above this size the type shown in Fig. 3 is used.

SIGNALING SYSTEM FOR MINES.

The Western Electric Company is placing on the market a new design of emergency signaling apparatus for mines which complies fully with the laws of Illinois and other States regulating the use of telephones and emergency signaling systems in mines.

The new signaling system consists of a generator signaling set and the regulation emergency 8-in. signal bells or gongs.

Figs. 1 and 2—Signaling Apparatus for Mines.

The generators used in the signaling sets are designed in two sizes to accommodate systems which require a large or small equipment of gongs.

The smaller of the two generator equipments consists of a five-bar magnet generator mounted in an iron case, as shown in Fig. 1. In appearance this case is similar to that of the new mine telephone set which the Western Electric Company placed on the market a few months ago. This five-bar generator will operate the equivalent of 20 8-in., loud-ringing extension bells over eight miles of full metallic No. 12 iron wire. The magnets of the generator are of the highest-grade magnet steel and are hardened and aged to insure retaining their strength indefinitely. The bearings are large and well proportioned, and the crank furnished is of a design which enables the generator to be operated easily when fully loaded.

The larger signaling set consists of a 14-bar magnet generator mounted in a metal case similar to that of the five-bar magnet equipment and is similar to that equipment in every detail except size. This generator will ring the equivalent of 60 8-in. gong emergency bells over an eight-mile line.

In each of these types the generator is arranged in an iron box provided with a padlock, ordinarily to be kept locked. To protect the generator when the outer door of the box is opened, a steel cover is fastened over the opening of the box and in front of the generator. This cover removes the pos-

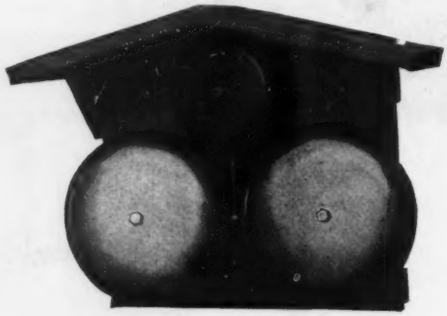


Fig. 4—Signal Bell or Gong.

sibility of any part of the clothing of the party operating the generator being caught in the generator wheels and also protects the generator from interference by other foreign substances which might collect should it be exposed while the door is open.

A compartment in the front of the door of the box equipped with a glass front is provided for the key to the set. It is the intention that a key to the set shall always be kept in this compartment, and that this key will be used only in cases of emergency, when anyone may break the glass front and obtain the key to open the set. This compartment is to be made air-tight so that it will be impossible for dust to get inside and hide the key from view. The back of this compartment is to be painted white so as to make the key more noticeable.

It is also intended that the foreman or man in charge of the mine shall be provided with an extra key to enable him to open the box under ordinary conditions in the mine when it is desirable to operate the generator for fire or emergency-call drill.

The same precaution against water following the line wires into the case of the signaling set is taken as in the Western Electric new design of mine telephone. The curved inlet at the top provides an entrance which removes the possibility of water flowing along the line wires and into the set.

The emergency signal bell used with the generators consists of a non-sparking bell provided with two 8-in. steel gongs mounted upon a wooden or steel backboard and having a protecting canopy. The gongs are hot-galvanized and have an especially loud and clear tone. All parts, including the windings, are treated to stand conditions of mining atmosphere.

The signal system above described may be used with or independent of a telephone system. For mine telephone service the Western Electric Company has new designs of metal and wood telephone sets, and also a new design of an intercommunicating metal mine set.

Convention Exhibit Echoes.

Whatever fault may have been found with the meeting rooms at the convention of the National Electric Light Association at St. Louis, May 23-27, nothing but the most favorable comment was heard of the arrangements and decorations in the Exhibition Hall. The exhibition committee is justifiably proud of its work at St. Louis, for never were the exhibits of Class D members so tastefully arranged and housed. The number of official exhibitors was 69, and their contribution to the interest of the convention was by no means trifling. Viewed from the galleries surrounding the Exhibition Hall the scene was one of magnificence. A complete list of the exhibits was published in these columns last week, with a photograph taken before all the exhibits were in place. A number of views of the Exhibition Hall taken after the exhibition opened are printed herewith.

Following is a list (as complete as it could be made) of the manufacturers represented at the St. Louis convention of the N. E. L. A, who did not have exhibits:

Adams-Bagnall Electric Company, Cleveland, Ohio, represented by T. E. Adams, J. C. Pomeroy.

American Carbon & Battery Company, East St. Louis, Ill., represented by Henry Wrape, Harold J. Wrape, P. H. McGauly.

American Circular Loom Company, Boston, Mass., represented by Alex Henderson.

American Conduit Manufacturing Company, Pittsburgh, Pa., represented by A. G. McClure.

American Electrical Works, Providence, R. I., represented by E. H. Hammond.

Ansonia Electrical Company, Ansonia, Conn., represented by W. J. Tonkin.

Arrow Electric Company, Hartford, Conn., represented by E. R. Grier.

Archbold-Brady Company, Syracuse, N. Y., represented by W. K. Archbold.

Banner Electric Company, Youngstown, Ohio, represented by N. L. Norris, J. E. Hart, J. M. Martin.

Brilliant Electric Company, Cleveland, Ohio, represented by H. H. Cudmore.

Buckeye Electric Company, Cleveland, Ohio, represented by L. P. Sawyer, J. H. Cook.

Carbondale Machine Company, Carbondale, Pa., represented by Heywood Cochran.

Cary Company, Edward E., New York, N. Y., represented by E. E. Cary.

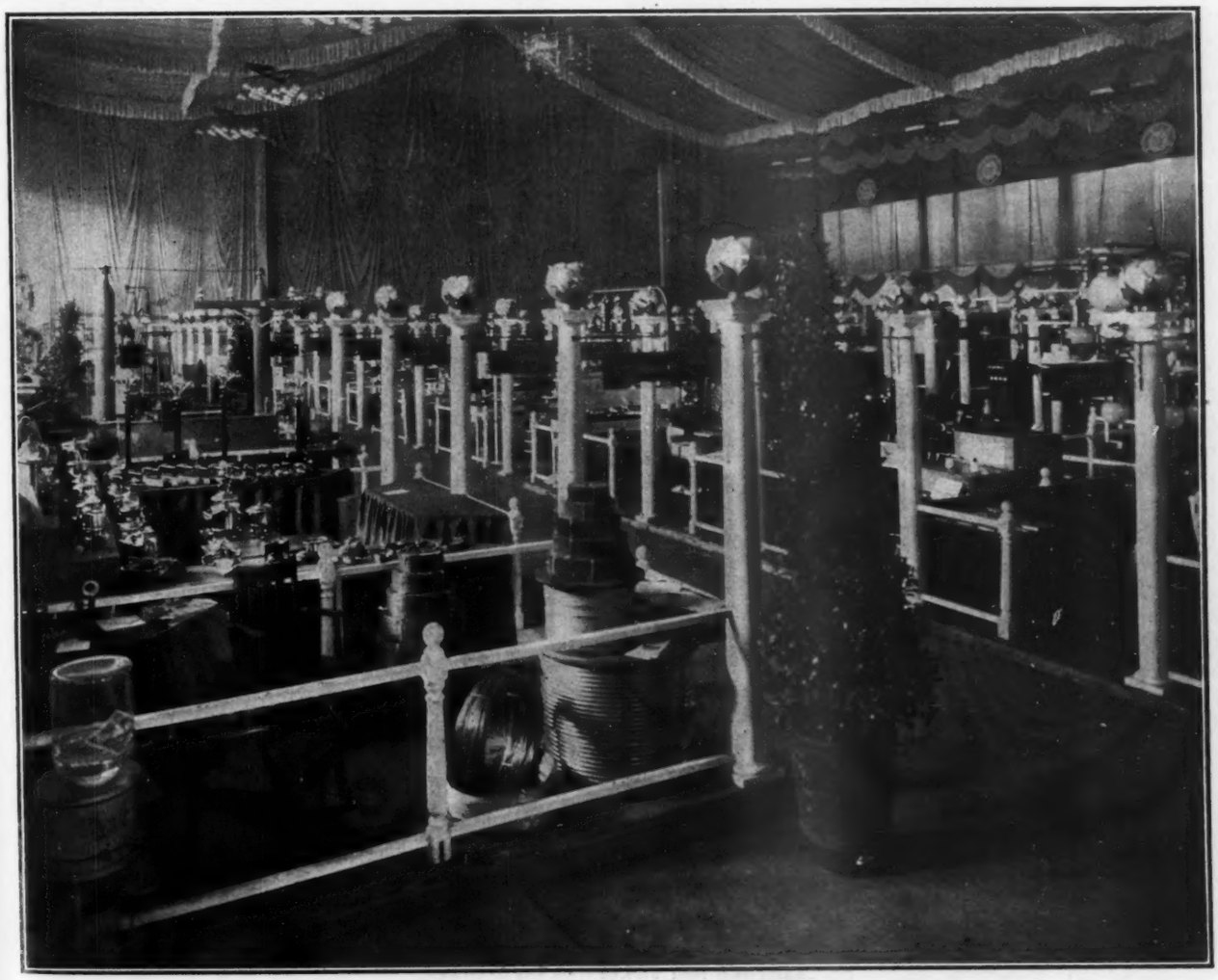
Colonial Electric Company, Warren, Ohio, represented by E. N. Beach.

Condit Electrical Manufacturing Company, Boston, Mass., represented by A. E. Greene, Frank Masterson.

Corrao, William A., Electric Company, St. Louis, Mo., represented by Otto Kuhn.

Crouse-Hinds Company, Syracuse, N. Y., represented by H. B. Crouse, Edward G. Mack.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., represented by R. I. Phillips, R. M. Van Vleet.



Exhibition Hall Viewed from the Northeast.

Delta Star Electric Company, Chicago, Ill., represented by H. W. Young.

Detroit Fuse & Manufacturing Company, Detroit, Mich., represented by A. H. Kling.

Electric Bond & Share Company, New York, N. Y., represented by F. A. Farrar.

Electric Motor & Equipment Company, Newark, N. J., represented by S. H. M. Agens.

Electrical Engineers' Equipment Company, Chicago, Ill., represented by R. M. Babbitt.

Electrical Testing Laboratories, New York, N. Y., represented by Preston S. Millar.

Excello Arc Lamp Company, New York, N. Y., represented by H. M. Hirchberg, George W. Armstrong.

Fiber Conduit Company, Orangeburg, N. Y., represented by W. N. Smythe, Jr., W. K. Sparrow.

Franklin Electric Manufacturing Company, Hartford, Conn., represented by P. S. Klees, C. W. Brainerd.

General Incandescent Lamp Company, Cleveland, Ohio, represented by H. C. Rice.

Gest, G. M., New York, N. Y., represented by W. T. Jackson.

Gould Storage Battery Company, New York, N. Y., represented by R. N. Chamberlain.

Holophane Company, New York, N. Y., represented by V. R. Lansingh.

Jandus Electric Company, Cleveland, Ohio, represented by C. L. Eshleman, W. L. Cumminsky.

Keller Manufacturing Company, Philadelphia, Pa., represented by Francis Raymond.

Kiewert, Charles L., Manufacturing Company, New York, N. Y., represented by H. W. Fowzer.

Kuhlman Electric Company, Elkhart, Ind., represented by E. Kuhlman.

Massachusetts Chemical Company, Boston, Mass., represented by A. E. Duclos.

Monarch Incandescent Lamp Company, Chicago, Ill., represented by J. S. Corby, L. G. Osborn.

National Carbon Company, Cleveland, Ohio, represented by J. S. Crider, N. C. Cotabish, J. F. Kerrlin, C. W. Wilkins, A. E. Carrier, F. J. Kyscia.

New York & Ohio Company, Warren, Ohio, represented by R. E. Gorton.

Novelty Incandescent Lamp Company, Emporium, Pa., represented by R. K. Mickey.

Okonite Company, New York, N. Y., represented by George T. Manson, Romaine Mace.

Oneida Community, Ltd., Oneida, N. Y., represented by J. C. Gibson.

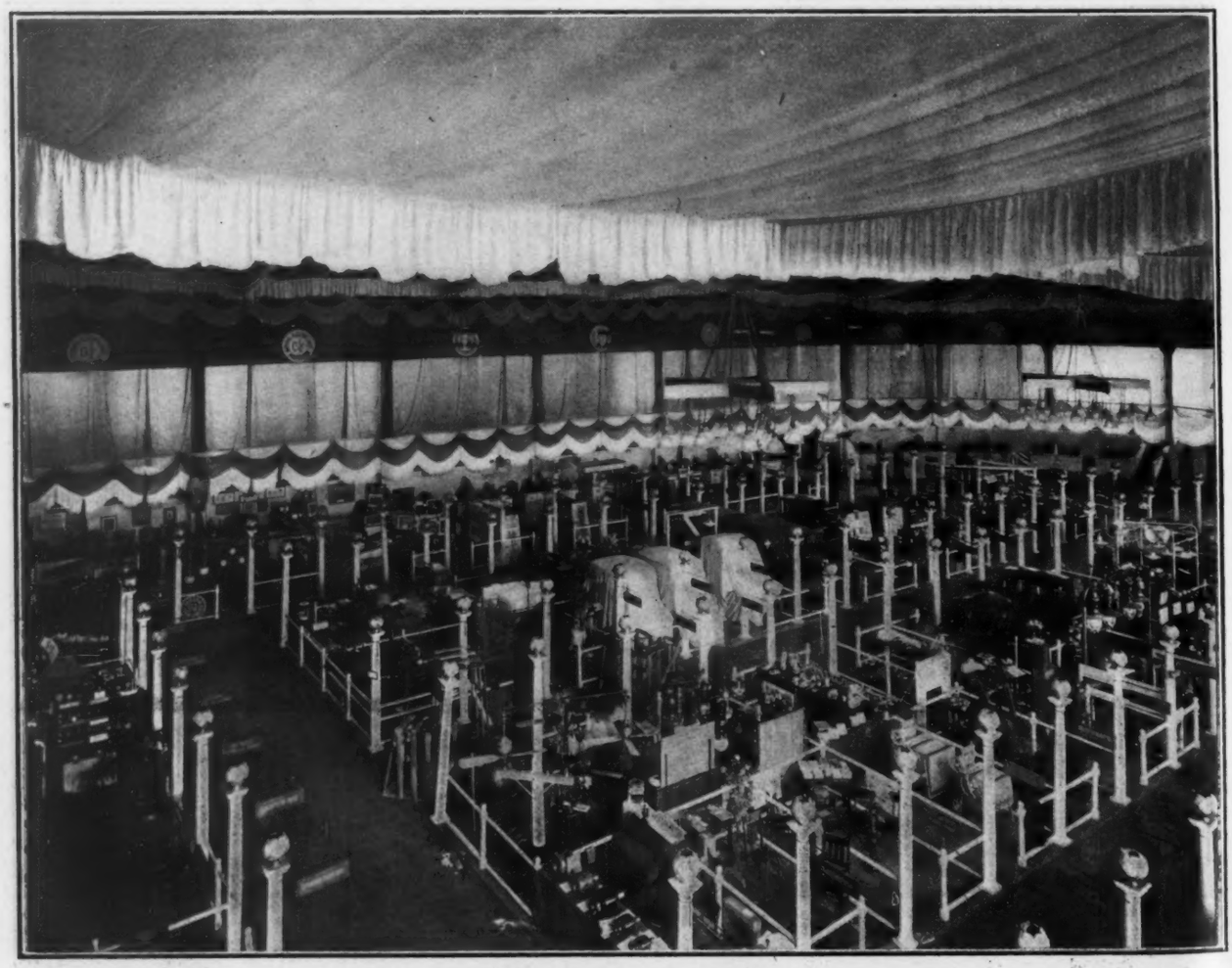
Peerless Electric Company, Warren, Ohio, represented by John B. Estabrook.

Pettingell-Andrews Company, Boston, Mass., represented by W. J. Keenan.

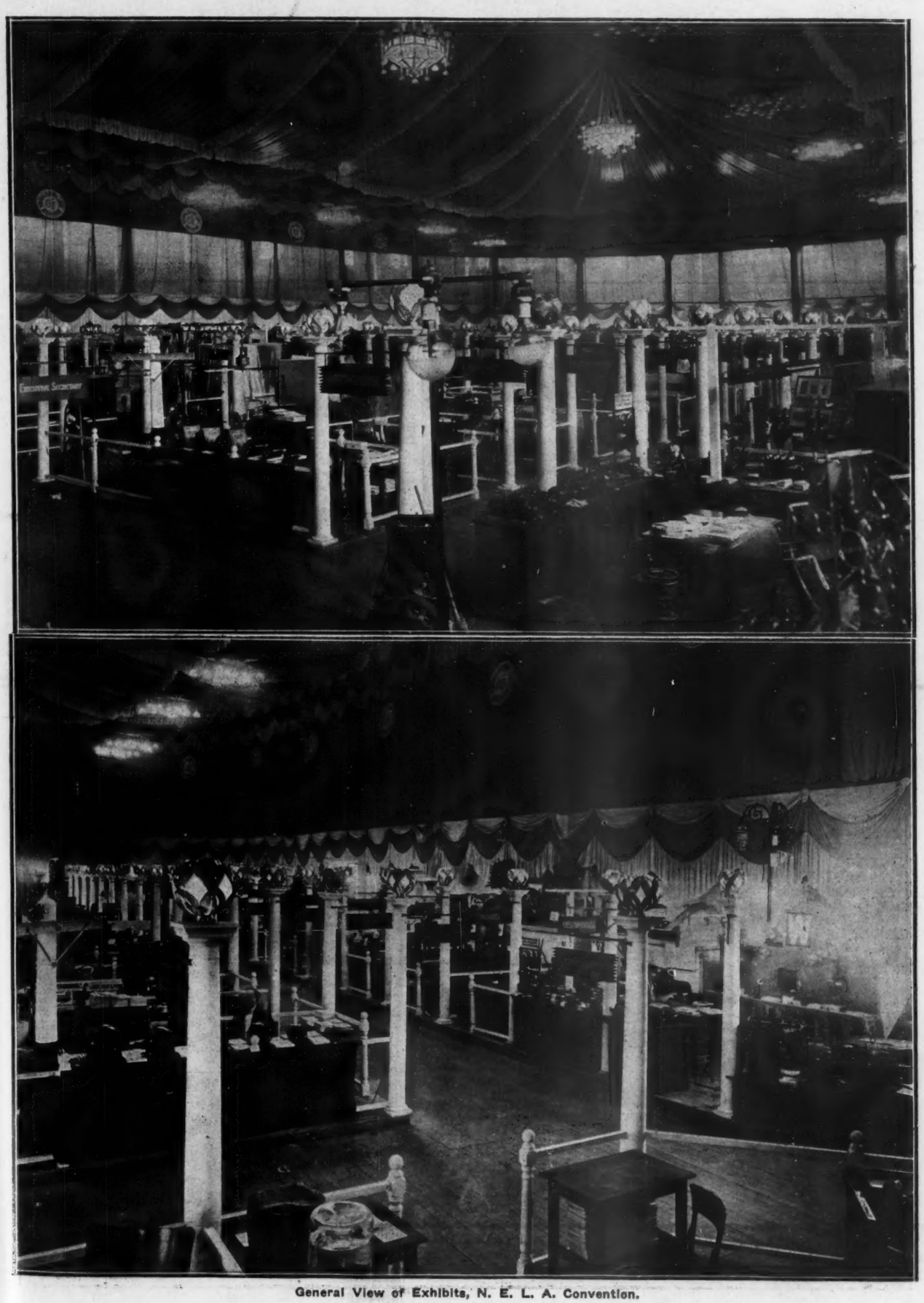
Philadelphia Storage Battery Company, Philadelphia, Pa., represented by Theo. B. Entz.

Pittsburgh Reinforcing Pole Company, Pittsburgh, Pa., represented by W. A. McCombs.

Phoenix Glass Company, Pittsburgh, Pa., represented by H. H. Patterson.



Exhibition Hall Viewed from the Southeast.



General View of Exhibits, N. E. L. A. Convention.

Reisinger, Hugo, New York, N. Y., represented by C. A. Du Bosch.

Siemens-Schuckert Company, New York, N. Y., represented by Dr. Karl G. Frank.

Simplex Electrical Company, Boston, Mass., represented by H. R. Hixon.

Stave Electrical Company, New York, N. Y., represented by Theo. Stave.

St. Louis Electric Heating Company, St. Louis, Mo., represented by J. A. Howze.

Sterling Electrical Manufacturing Company, Warren, Ohio, represented by W. A. Coale.

Stewart, John A., Electric Company, Cincinnati, Ohio, represented by John A. Stewart, Paul Stewart.

Sykes, A. L., Manufacturing Company, Cincinnati, Ohio, represented by A. L. Sykes.

Tungstolier Company, Cleveland, Ohio, represented by E. J. Kulas, F. C. Maxheimer.

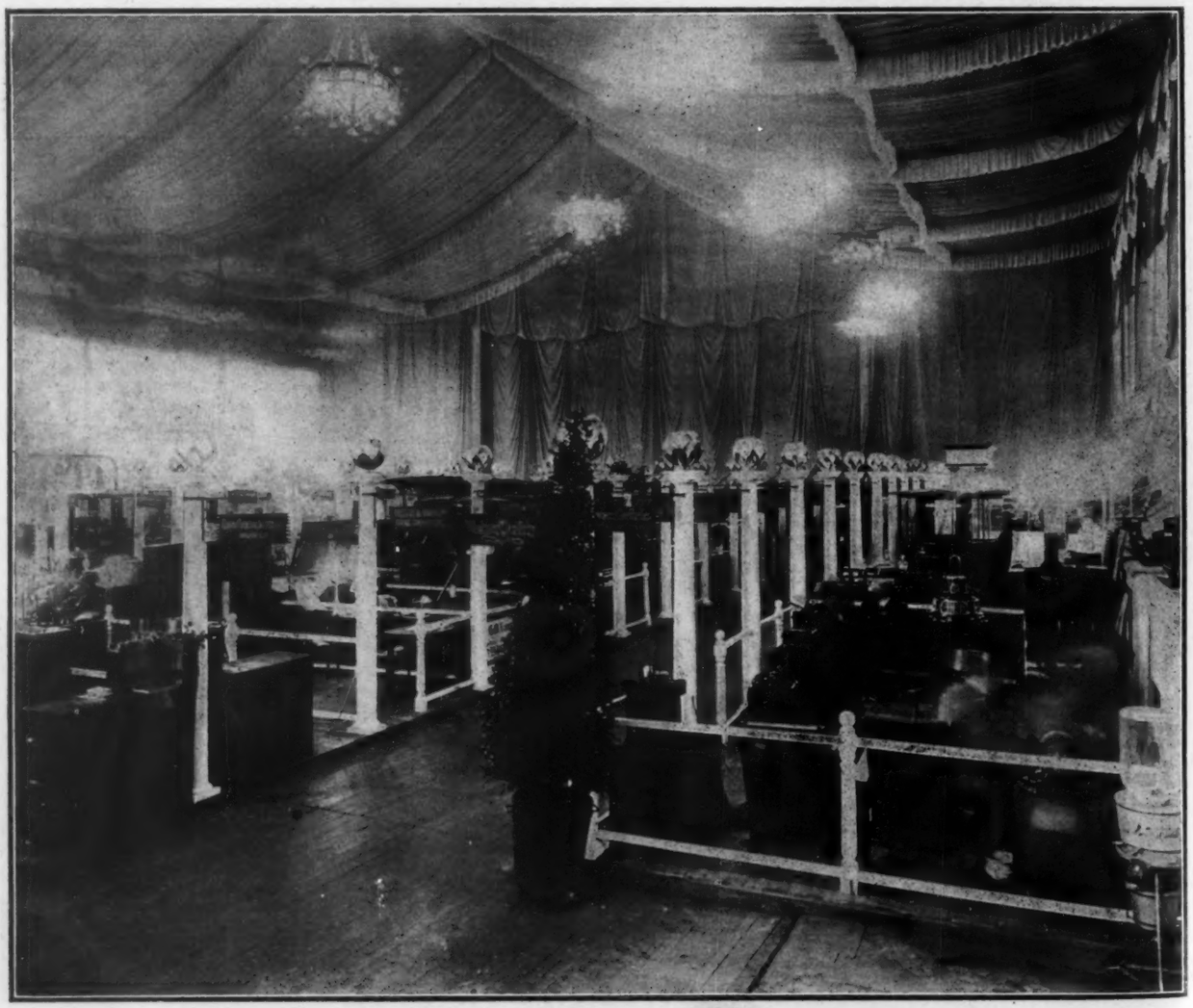
Weston Electrical Instrument Company, Waverly, N. J., represented by Milton Mill.

Ward Leonard Electric Company, Bronxville, N. Y., represented by D. J. Burns.

Mr. L. P. Sawyer, of the Buckeye Electric Company, Cleveland, gave a dinner on Tuesday night at Tony Faust's to some 15 of his N. E. L. A. friends. The affair was characterized by those fortunate enough to be there as most enjoyable, and the carefully selected menu gave evidence of the epicurean taste of the host. Among the guests were Messrs. Orr, Hegarty, Doane, Harvey, Drake, Crouse, Wakeman, Warner, Cook and Martin.

The Electrical World occupied a booth in Exhibition Hall, and was represented at the convention by Messrs. H. M. Wilson, J. M. Wakeman, G. W. Elliott, W. K. Beard, C. T. Walker, H. T. Matthew and D. A. Gordon of the business staff, and by Messrs. W. E. Keily, O. H. Caldwell, A. S. McAllister, W. H. Onken, Frederic Nicholas and J. R. Cravath of the editorial staff. The issue distributed at the convention had the distinction of being the largest issue of any electrical paper that has ever been published, either in this country or abroad.

Mr. Philip S. Dodd appeared at the convention in his new rôle of publicity manager for the National Electric Lamp Company. Mr. Dodd's previous newspaper experience has proved very valuable to him in his present capacity and the manufacturers of incandescent lamps feel that they made no mistake when they persuaded him to abandon the technical journal field to join their ranks. During the summer, while the lamp men spend their vacations, Mr. Dodd looks after their creature comforts at the Association Island, where the lamp companies maintain a permanent camp. Mr. Dodd has demonstrated his versatility by taking good care of the company's interests there just as well as he does in the publicity department. While he was always popular with the other technical journal men even when a competitor he is even more so now that he has joined the ranks of the advertisers.



Exhibition Hall Viewed from the Northwest.

Industrial and Commercial News

THE WEEK IN TRADE.

REPORTS of trade for the past week show that in almost every line there is still abundant evidence of conservatism, and that business might be termed slack. While the jobbers and wholesalers are taking a few orders, these are mostly to fill in broken stocks. Fall trade is very light. Buyers do not seem to be willing to commit themselves at the present time, and retail trade throughout the West, and in fact all over the country, fails to reach the expectations upon which the buying of the early winter was based. There has been some gain in the Northwestern section of the country, and owing to the fact that harvest is at hand, in Texas there is an improvement in that State. The unseasonably cool weather is generally assigned as the cause for backward trade, but there is undoubtedly a feeling of uncertainty as to prices which also checks many buyers. Crop reports are better than earlier in the season, and this is especially true with regard to small grain and cotton. In the industrial world there is a rather more cheerful feeling in iron and steel, which is based on the fact that recent shutdowns have curtailed the production of raw material, and this has steadied the market to a firmer price basis. Similar curtailments in many textile lines are improving the situation. The cotton mill curtailment promises to be more widespread within the next two weeks than at any time since the resumption of normal conditions. A full week's shutdown in many Eastern mills is scheduled. Probably the most encouraging feature of the past week was the sharp break in wheat and other cereal prices in the Chicago market. American prices are still, however, considerably above the foreign parity. Exports are improving as our price level becomes nearer that prevailing in Europe. Collections can be classed only as fair, the dull condition of retail trade having a serious effect upon them. Business failures for the week which ended May 26, as reported by *Bradstreet*, were 200, as against 225 the previous week, 205 in 1909, 263 in 1908, 142 in 1907 and 127 in 1906.

THE COPPER MARKET.

THERE was no improvement in the condition of the copper market during the past week. It can hardly be better descfibed than to call it "featureless." Official prices ranged a trifle lower during the week, and there were many reports that the independent producers were making concessions to small purchasers of copper. There was little domestic buying, except among these small concerns, and sales were almost exclusively confined to unimportant lots. Exports have been only fair, but imports have been steadily growing. During the last week large quantities of copper were received from foreign countries, and there are indications that the imports during May will be the heaviest in the history of the trade. This condition, of course, has a depressing effect upon the market, and causes consumers to delay their purchases, in the reasonable expectation of lower prices. While manufacturers of finished materials, especially wire drawers and the electrical companies, report a fair volume of current business, they seem to be well enough supplied with raw material at the present time to be in no hurry about laying in additional stocks. In the meantime the production of copper is continuing at about the same high daily record as was established in April, and there is every reason to believe that the increase of surplus stocks at the end of the month will be much heavier than the increase that was recorded when the last report of the Copper Producers Association was made. The copper market abroad is easier and prices are slightly lower. There is very little speculative buying, and some evidence in London of a disposition to liquidate long accounts. Exports for May, including May 27, the last day under review, were 19,666 tons. The daily call on the Metal Exchange, May 27, quoted standard copper as per the accompanying table.

Standard copper.	Bid.	Asked.	Settling price.
Spot	12.45	12.55	....
May	12.45	12.55	12.50
June	12.45	12.55	12.50
July	12.47½	12.55	12.50
August	12.50	12.55	12.52½

The London market May 27 was as follows:

	Noon. £ s. d.	Close. £ s. d.
Standard copper, spot	56 15 0	56 12 6
Standard copper, futures	57 12 6	57 10 0

Extreme fluctuations for this year:

	Highest. Cents.	Lowest. Cents.
Standard	13.50	12.05
London, spot	62 0 0	55 2 6
London, futures	65 18 9	56 2 6
Best selected	65 10 0	59 10 0

COMMERCIAL AND INDUSTRIAL NOTES.

Co-operation of Westinghouse Companies. — George Westinghouse in an interview published last week said, with regard to the co-operation between the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company, that when these two concerns established their plants in East Pittsburgh in 1894 there began a close co-operation between them, which has been maintained ever since to their great mutual advantage. "Each company has endeavored to aid the other in securing business," said he, "and, except at the beginning of their operation, neither company has paid any commission or compensation to the other. While the public is familiar in a general way with the fact that the business of the several Westinghouse companies is now better than ever before, and that the progress of the Machine company is exceptionally gratifying, yet very few realize the part the Machine company has played in the development of the electrical industry, especially in adding enormously to the business and profits of the Westinghouse Electric & Manufacturing Company. It is perfectly plain that without the capital and facilities of the Machine company the Electric company would have been obliged to content itself with an ordinary place in the electrical industry, or to have raised the many millions of additional capital now employed by the Machine company. The Machine company's activities during the past two years have brought a very great increase in the business of both companies. The more recent, and in a sense the more important, developments which will give new lines of business to both companies are those relating to condensers for steam engines, small steam turbines of high efficiency and moderate cost to supplant small reciprocating engines, large or high-power gas engines and a successful soft coal gas producer."

Wireless Service in Brazil.—The United Wireless Telegraph Company has signed a contract with the Lloyd Brazilerio, a subsidized line of steamships serving Brazilian ports and maintaining a service between Brazil and New York, for a complete wireless system upon 21 ships. It has also contracted with the same company to construct eight stations along the Brazilian coast. The service is primarily for the steamship company, of which the government owns two-thirds, but it is understood that the telegraph service will also be open to the public. One land station is to be at Rio Grande do Sul, one at Santos, three in and near Rio de Janeiro, one at Bahia, one at Pernambuco and one at Para. The system will be operated by modern American methods, and all the ships except those running to New York will be at all times in communication with the land stations.

Bergmann Electrical Works.—The Bergmann Electrical Works, Berlin, Germany, did a gross business last year of 37,586,500 marks, against 23,031,600 marks the previous year. The number of workmen now employed is 7,500. To provide for expansion of business, the capital will be increased from 21,000,000 to 29,000,000 marks. A dividend of 18 per cent is being paid on the present capital. The firm has taken up the manufacture of both electric and gasoline vehicles.

Snake River Irrigation Company.—Plans have been perfected by the Snake River Irrigation Company of Boise, Idaho, for the completion of its hydroelectric project at Castle Butte. Work will begin at once on a power house and dam which are expected to cost about $500,000, and equipment will be installed capable of generating 10,000 hp. The first undertaking of the company will be the irrigation of 10,000 acres of fruit land.

New Haven Railroad Lighting Properties.—The New York, New Haven & Hartford Railroad Company has transferred to the Housatonic Power Company all of its gas and electric lighting interests, owned or leased. These include the lighting plants at Norwalk, South Norwalk, Greenwich, Naugatuck, Waterbury and New Britain. The Housatonic company already controls the New Milford Power Company, which supplies traction energy to Waterbury, New Britain and other towns in Connecticut. The Housatonic company originally had a capital of $1,000,000, but its capital has recently been raised to $3,000,000 to pay for the newly acquired properties, the increase having been permitted by the company's charter. The effect of this transfer is the segregation of the power and lighting companies of the New Haven system from its trolley properties. They will be operated entirely separate for the sake of simplicity of bookkeeping.

Montreal Light, Heat & Power Company.—According to the report of the Montreal Light, Heat & Power Company for its fiscal year, which ended April 30 last, the net earnings, after deducting all fixed charges and taxes, were approximately $1,800,000. This compares with $1,745,847 in the previous year. There is much interest felt by those associated with this company in the effect upon it of the competition which it will soon have. The Dominion Light Company has commenced already the installation of a transmission system in one section of the city, and the Montreal Light, Heat & Power Company has voluntarily reduced its rates in that territory. The company's property is in a high state of operating efficiency, and financially its position is very strong.

Orange County Traction Company.—Authorization has been given by the Public Service Commission of the Second District of New York to the Orange County Traction Company to issue a $750,000 mortgage on its property and franchises to the Union Trust Company, in order to secure a 50-year 5 per cent bond issue. The bonds are not to be sold at less than 85. Of this issue $233,800 are to be issued at once for the discharge of indebtedness, and for additions, improvements and equipment. The company may also issue $125,000 of bonds for refunding purposes, to be exchanged for outstanding bonds at par. Former Governor B. B. Odell, Jr., is president of the company.

Los Angeles Pacific Company.—According to reports received from the West, the Southern Pacific Company has acquired the minority interest in the Los Angeles Pacific Company, and now holds all its stock. This minority interest was left outstanding after control was obtained eight or nine years ago, and amounted to something less than $500,000 out of the $15,000,000 of stock. It has now been acquired from the Sherman-Clark interests which promoted the company. The Los Angeles Pacific Company operates about 200 miles of electric line in Southern California, and is one of several important electric tractions controlled by the Southern Pacific Company.

Consolidated Gas Company of Baltimore.—It is understood that negotiations have been closed with New York bankers looking to the retirement of the 6 per cent bonds of the Consolidated Gas, Electric Light & Power Company of Baltimore. These bonds mature July 1, 1910. It is said that these negotiations provide for the issue of short term notes instead of for the sale of the 4½ per cent bonds which was at first contemplated. The condition of the bond market at present is probably responsible for this change of program.

Salem Electric Light Company.—The Massachusetts Gas Commissioners have been petitioned by the Salem Electric Light Company for authority to increase its capital stock by the issuance of 5,000 shares at $62.50 per share. As the par value of the stock is $50, this amounts to an increase of $250,000 in capitalization. The proceeds are to be applied to the cancellation of floating debts.

DIVIDENDS.

Laclede Gas Light Company, preferred semi-annual, 2½ per cent; common, quarterly, 1½ per cent, both payable June 15.

Mackey Companies, quarterly preferred, 1 per cent; common 1¼ per cent, both payable July 1.

Massachusetts Electric Companies, preferred semiannual, 2 per cent, payable July 1.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable June 30.

Norfolk (Va.) Railway and Light Company, semiannual, 2 per cent, payable June 2.

North American Company, quarterly, 1¼ per cent, payable July 1.

Oklahoma Gas & Electric Company, quarterly, 1½ per cent, payable June 15.

Portland Railway, Light & Power Company, preferred quarterly, 1¼ per cent, payable July 1.

San Diego Consolidated Gas & Electric Company, quarterly, 1½ per cent, payable June 15.

Twin City Rapid Transit Company, preferred quarterly, 1¾ per cent, payable July 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Light & Traction Company:					
April, 1910	$274,605	$9,424	$265,181		
April, 1909	238,448	9,184	229,264		
Aurora, Elgin & Chicago Railway Company:					
April, 1910	120,383	71,149	49,234	$33,310	$15,924
April, 1909	106,411	64,182	42,229	28,552	13,677
Cleveland, Painesville & Eastern Railroad Company:					
April, 1910	25,206	13,236	11,970	8,713	3,257
April, 1909	21,805	12,558	9,247	8,282	965
Detroit United Railway Company:					
April, 1910	724,811	486,897	237,914	161,489	89,222
April, 1909	608,025	374,203	233,822	154,155	91,347
East St. Louis & Suburban Company:					
April, 1910	171,640	95,827	75,813	52,270	25,543
April, 1909	160,346	89,543	70,803	50,579	20,226
Grand Rapids Railway Company:					
April, 1910	86,632	44,052	42,580	19,593	22,987
April, 1909	77,625	37,291	40,334	18,875	21,459
Kansas City Railway & Light Company:					
Year ended March 31, 1910	7,108,978	4,464,275	2,644,703	1,429,181	1,215,522
Year ended March 31, 1909	6,462,358	4,113,033	2,349,325	1,421,328	927,997
Lake Shore Electric Railway Company:					
April, 1910	86,915	48,513	38,402	34,902	3,500
April, 1909	78,574	45,651	32,923	34,353	*1,430
Lewiston (Me.), Augusta & Waterville Street Railway Company:					
April, 1910	37,883	24,221	13,662	14,432	770
April, 1909	34,579	22,341	12,238	13,253	1,015
Niagara, Lockport & Ontario Power Company:					
April, 1910	40,602	16,086	24,516	20,833	5,146
April, 1909	23,061	15,903	7,157	20,833	*10,899
Norfolk (Va.) & Portsmouth Traction Company:					
April, 1910	155,337	91,987	63,350		
April, 1909	138,858	87,817	51,041		
Northern Ohio Traction & Light Company:					
April, 1910	173,763	103,683	70,080	43,292	26,788
April, 1909	151,906	89,586	62,320	43,779	18,541
Portland (Me.) Electric Company:					
April, 1910	31,979	10,529	21,450	9,380	12,070
April, 1909	27,599	10,487	17,112	9,194	7,918
Twin City Rapid Transit Company:					
April, 1910	584,377	268,045	316,332	140,229	176,103
April, 1909	537,049	261,713	275,336	140,367	134,969
Union Railway Gas & Electric Company:					
April, 1910	230,323	131,780	98,543	65,499	33,146
April, 1909	216,016	109,694	106,322	163,892	42,430
Western Ohio Railway Company:					
April, 1910	42,025	22,354	19,671	15,403	4,268
April, 1909	37,035	20,042	16,993	15,364	1,629

* Deficit.

New Process for Guayule Rubber.—New machinery has been invented for extracting rubber from the guayule shrub. A large factory is being erected at Terreon, Mex., in which the new equipment is being installed. It will be one of the largest guayule rubber factories in Mexico. It is claimed by E. Delafond, a French engineer who invented the new process, that it will produce a higher grade of rubber than is obtained by the methods now used. He also says that about 40 per cent more rubber will be obtained from the shrub by the use of the new machines than of the old methods. The guayule rubber industry has had a marvelous development in northern Mexico during the last few years. There are several large rubber factories in Terreon and that immediate section. Associated with Mr. Delafond in the enterprise are a number of Mexicans who own large tracts of land upon which the guayule shrub grows abundantly. It is stated that there will be no lack of supply of the raw material. The big advance in price of crude rubber is making fortunes for the guayule rubber manufacturers of Mexico. The market price of the shrub is also steadily advancing. A number of contracts were recently made at $200, Mexican currency, per ton. The thorough demonstration of the fact that the shrub can be reproduced from the seed has added strength to the industry, as its permanency is considered assured.

Frisco Road and Telephone Dispatching.—The St. Louis & San Francisco Railroad, which has been active in the campaign among the railroad systems of the country to supplant the use of the telegraph with the telephone for train dispatching, is now installing new telephone circuits over about 500 miles of its line. The circuits now in course of construction extend from St. Louis to Springfield, Mo., from Springfield to Thayer, Mo., and from Amory, Miss., to Birmingham, Ala. Trains on the Frisco are now being dispatched by telephone between Kansas City and Springfield on the northern division, and on the Lebanon division between Springfield and Monett, Mo., a total distance of about 246 miles. This part of the Frisco is single track and the traffic between Kansas City and Fort Scott is unusually heavy. The fact that the telephone dispatching circuit in this busy district has proved satisfactory to the operating officials influenced their decision to extend the system over more territory. The equipment which is now in service and that which is soon to be installed consists of telephone apparatus and selectors purchased from the Western Electric Company. Message circuits, on which the commercial business is handled, parallel in every case the dispatching circuits, which are used exclusively to direct train movements and traffic.

Chicago Subway Development.—The efforts of the receivers and reorganization committee of the Chicago Subway Company are being concentrated entirely upon the completion of the telephone system. In order to save its franchise, the company will have to complete the telephone system before June 1, 1911, to the extent of having 20,000 telephones installed. The contractors are now at work in the tunnel placing the wires, and barring any unforeseen interferences, this number of telephones is expected to be ready for operation by next December. It is claimed by a representative of the Chicago Subway Company that the Illinois Tunnel Company, which operates the freight line, is now earning a small income over and above operating costs and taxes. The question of stock and bond readjustment has not as yet been taken up, and no steps in this direction are likely until the receivers and reorganization committee know the outcome of the present undertakings.

National Carbon Company.—The earnings of the National Carbon Company for the first four months of 1910 were very close to 18 per cent on the common stock, before allowing for depreciation. At present, the company is earning at the rate of 13 per cent on its entire capitalization of $10,000,000. The large expansion in gross sales of the big electrical companies during the last year has been a material factor in helping the Carbon company. The business of the company is subject to less fluctuation than almost any other line affiliated with the electrical industries, and it is claimed by the officials that an earning standard once established has always been maintained. It is expected that the common stock will shortly be placed upon a 7 per cent dividend basis, the same as the preferred.

Crocker-Wheeler Turbo-Generators.—The Crocker-Wheeler Company has recently sold two 3530-kva, 2300-volt, a.c. turbo-generators to the Illinois Steel Company. They are to be installed by the Ball & Wood Company at the South works in Chicago. Excitation will be effected by two 35-kw, 125-volt Crocker-Wheeler generators, direct-connected to the end of the generator shafts, the armature of each to be connected electrically with the turbo-generator field without any regulating resistance whatever in its circuit. The regulation of the alternators will be brought about altogether by adjusting the strength of the exciter fields. There will be no disconnecting switch between the armature of the exciter and the field of the generator.

Commercial Cable Company.—Clarence H. Mackay, president of the Commercial Cable Company, denies that his company has formed any sort of an alliance with its competitor, the Anglo-American Telegraph Company. He does not deny that it has purchased a considerable block of stock in the latter company. Mr. Mackay says: "The Commercial Cable Company never has had, has not now and does not intend to have any connection whatsoever with its competitor, either in the way of controlling its stock or making any traffic agreement. The Commercial Cable Company will continue to be independent and competitive, just as the Postal Telegraph-Cable Company will continue to be independent and competitive."

New Haven to Use Multiple Unit Trains.—Within the last few months the New Haven Railroad has made important improvements in its electric service between Stamford and New York, which in time will result in large economies of operation. Chief of these is the installation of a multiple unit train service for suburban traffic. The road is now operating in this zone trains of two or three cars, one car being both a motor and passenger car and the others trailers. It is expected to extend this service to longer trains, using more motor cars in each train. These trains will be similar to those used in the subway.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable new extensions of present plants at Indianapolis, Ind.; Bryan, Tex.; Burlington, Vt.; Waterville, Que., Can.; Brockville, Ont., Can.; Milwaukee, Wis.; Island, Ky.; Trenton, Tenn.; Greenville, Ohio; Detroit, Mich.; Marinette, Wis.; Kankakee, Ill.; Red Lake Falls, Minn.; Hamilton, Ont., Can.; Monticello, Ia.; Elba, Ala.; Augusta, Ga.; Cherokee, Okla.; Cleveland, Ohio; Dalton, Ga.; Cincinnati, Ohio; Portland, Ore., and Delaware, Ohio.

The New Wire Supervision Law.—The provisions of the new law giving the Public Service Commission of the Second District supervision over telephone and telegraph companies are not as far reaching as those exercised by the commissions over railways. The wire corporations may issue bonds for improvements, extensions and other causes without asking the approval of the commission. New lines, however, cannot be run, or extensions to existing lines made, until the commission has given its approval. The commission will also have authority over rates, except where contracts already exist.

Heavy Demand for Lead.—An official of one of the largest lead producing companies in this country says that the demand for that metal at the present time is extremely heavy. There has been a good amount of buying for many months, but within the last few weeks this has increased. This official is of the opinion that the users of lead had allowed their stocks to run down, and that this has occasioned the heavy demand at the present time. Prices, however, are only slightly advanced, and buyers do not seem to be in a position of being forced to pay any figure that is demanded.

Illinois Traction Company.—The new bridge which the Illinois Traction Company is building over the Mississippi River at St. Louis will be open about Sept. 1. The company is also building a 15-story steel-frame structure, which will be used as a passenger station and office building. Steel car sheds are being constructed in Granite City, Ill., opposite St. Louis, which will be 300 ft. long and about 60 ft. wide, and will afford accommodations for eight railway tracks. There will also be a large freight receiving station in St. Louis.

Mr. M. Abrahamson, of the firm of Tvermoes & Abrahamson, Copenhagen, Denmark, is in this country with a view to securing for his firm agencies from manufacturers of American electrical goods of all descriptions. Mr. Abrahamson may be addressed at the office of Melchior, Armstrong & Dessan, export and commission merchants, 116 Broad Street, New York.

Financial.

The Week in Wall Street.

CONDITIONS in Wall Street showed no improvement during the short week that preceded the holiday. Trading continued to be remarkably dull, and was almost exclusively confined to the regulars. Commission houses did very little business, and outside orders were very few. There were some evidences during the week of bear manipulation, and this class of traders had a comparatively easy time. The only trouble which they encountered was the fact that there were no buyers, and "wash sales" failed to impress the Street. When any one tried to sell a large block of stock, the market simply faded away and the offers were unheeded. The result of this condition was that the majority of active issues declined during the week from one to three points. As usual in such a situation, the rumor mongers were active and every day invented some new story tending to depress prices. The most serious of these was the report that J. P. Morgan was dangerously ill, a story which was at once disproved, and which has caused an investigation to be started by the Exchange. A very encouraging feature of the week was the sale of the $50,000,000 issue of 4 per cent 15-year bonds of the St. Paul Railroad Company in the Paris market. The rate paid for these bonds is said to be 97, but the sellers must pay the French taxes, which aggregate ⅜ per cent. From this it would seem that the company paid more than 5 per cent for its money. The local bond market was extremely dull, and investors were few. The money market, however, continues to be easy, with more funds available than customers. Quotations May 27 were: Call, 2½ @ 3½ per cent; 90 days, 3½ @ 3¾ per cent. The quotations in the table are those of the close, May 27.

NEW YORK.

	May 23.	May 27.	Shares sold.		May 23.	May 27.	Shares sold.
All.-Ch.	9⅜*	9⅜*	———	Int.-Met., pfd.	55⅞	54¾	10,950
All.-Ch., pfd.	34*	32½	200	Mackay Cos.	89*	87⅜	100
Amal. Cop.	70¾	69¾	103,500	Mackay C., p.	76*	76*	40
Am. D. T.	20½*	20½	———	Man. Elev.	134	136*	236
Am. Loc.	49	48¼	1,900	Met. St. Ry.	15*	15*	———
Am. Loc., pfd.	110	107½*	55	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75	———	Steel, com.	83⅝	82⅝	486,400
Am. T. & T.	136⅜	136⅛	4,000	Steel, pfd.	118¼	118	6,740
B. R. T.	81½	81	31,254	W. U. T.	68	67½	600
Gen. Elec.	150½	148¾	1,319	West'h., com.	65	64	600
Int.-Met., c'm.	20½	20⅛	4,700	West'h., pfd.	110*	110*	———

PHILADELPHIA.

	May 23.	May 27.		May 23.	May 27.
Am. Rys.	45	45*	Phila. Elec.	15⅜	15
Elec. Co. of A.	12*	11⅜*	Phila. R. T.	18¾	18¼
Elec. St. B'ty.	59½	60	Phila. Trac.	86	85
E. S. B'ty, pfd.	30*	30*	Union Trac.	48	47⅝

CHICAGO.

	May 23.	May 27.		May 23.	May 27.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	115½	117
Chi. Rs., Ser. 1.	90*	77*	Met. El., com.	19*	19*
Chi. Rs., Ser. 2.	17	18	Met El., pfd.	56½	56½*
Com. Edison.	113½	113	Nat'l Carbon.	109*	110*
Chi. Subways.	2¾	2⅝	Natn'l Car., pfd.	115	115*

BOSTON.

	May 23.	May 27.		May 23.	May 27.
Am. T. & T.	136¾	136⅜	Mex. Tel.	6¼	6*
Cum. Tel.	146*	146*	Mex. Tel., pfd.	6½	6¼*
Edison E., Ill.	250	250	N. E. Tel.	133	133½*
Gen. Elec.	151	149⅝	W. T. & T.	16*	15¾*
Mass. E. Ry.	17½	17½	W. T. & T., pfd.	88	87*
Mass. E. Ry., pfd.	86	85*			

* Last price quoted.
Shares sold for week of May 23 to May 27.

Financial Notes.

Pennsylvania and New Haven Alliance.—The Pennsylvania Railroad Company has recently been increasing its stock holdings in the New York, New Haven & Hartford Railroad. This has given rise to reports that the larger company was endeavoring to secure control of the New England line. These reports have been explicitly denied by President James McCrea of the Pennsylvania, and also by President Mellen of the New Haven. The explanation is that the Pennsylvania company desires to own enough stock to be entitled to another director upon the New Haven board, and it is expected that T. De Witt Cuyler, a director in the Pennsylvania, will be given the place. The Pennsylvania now owns about $6,000,000 of the New Haven stock out of a total of $120,000,000. An official of the company states that the Pennsylvania and New Haven have common interests in the situation in and around New York, and on this account it was considered advisable for the former company to become a larger stockholder in the latter. "There is nothing," said he, "in the purchase, or in the joint ownership of the projected bridge over Hell Gate to indicate an eventual ownership. The new Pennsylvania terminal will ultimately handle the through passenger business of the New Haven railroad, but will not handle the local or commutation traffic, except that originating in the territory east and south of New Rochelle, which can be handled more cheaply that way than by carrying it back to Woodlawn, as would be necessary to get it into the Grand Central Station."

Telephone Company in Receiver's Hands.—The Continental Telephone & Telegraph Company of New Jersey has been ordered by the United States Court at Trenton to show cause why a receiver should not be appointed on the ground of insolvency. The suit was brought by stockholders, the charges being mismanagement and misuse of funds. The Continental company was incorporated in November, 1909, with an authorized capital of $50,000,000 and an authorized bond issue of $25,000,000. The avowed purpose of the company was to consolidate various independent telephone lines operating in opposition to the Bell system. The company acquired the $10,000,000 capital stock of the National Telephone Corporation, and it is said that contracts have been made for the acquisition of various other properties. The president of the Continental company is John A. Howard, and its treasurer is Samuel W. Harper. These two officials are said to claim that the Continental company owes them over $1,000,000.

United Railways of Baltimore.—An increase in the earning of the United Railways of Baltimore of $40,000 is reported for April over the same month of last year. It must be taken into consideration, though, that the company was handicapped last year on account of the blizzard, which tied up for some time a great many of its lines. The wet weather prevailing in April interfered somewhat with traffic, but taking the month as a whole, the earnings were gratifying to the officials. The company has expended large amounts of money from time to time in improving the new Pratt Street power house. A short time ago it spent $15,000 in repairing its boilers there, and it is understood that since Stillwell & Company, the New York consulting engineers, were engaged to supervise the property several years ago. Five hundred thousand dollars has been spent on this power house.

Stone & Webster Properties Prosper.—The March earnings of the various Stone & Webster properties, reports of which have been made public, show very favorable increases. The returns for the year 1909 showed an increase in gross earnings of more than 15 per cent, and it is said that the ratio for the first quarter of 1910 is even better. A considerable amount of improvement work is under way in the various sections where these companies operate, and extensions are being made to almost every property. The Stone & Webster properties represent almost every section of the country, and their growth is therefore significant of the general prosperity of public utility properties.

Atlantic & Suburban Railway Sold.—The Atlantic City & Shore Railroad Company has purchased from John L. Clawson and Norman Grey, the Atlantic & Suburban Railway. The purchase price was close to $1,000,000, most of which was payable in 4 per cent trust certificates subject to a $100,000 mortgage which will be guaranteed by the purchasing company. The proceeds of the bonds, covered by the mortgage, will be used to reconstruct the line, which will be used to take care of the local business while the Shore line will be devoted to express service. The Atlantic & Suburban has 18 miles of track and connects Atlantic City, Absecon, Pleasantville and Somers Point.

Laclede Gas Light Company.—Reports that the Laclede Gas Light Company will increase the dividend rate upon its common stock are declared to be premature by interests connected with that company in St. Louis. Although probably more than 6 per cent could be paid, it is the policy of the directors to put the distributing system in a high state of efficiency, and to improve the plant so as to operate more economically, rather than to increase dividends.

Etowah Power Company.—All of the property and rights of the Etowah Power Company will be sold at Canton, Ga., June 7, under foreclosure judgment in a suit brought by the Knickerbocker Trust Company of New York. These holdings include all the water power rights on the Etowah River in Cherokee and Bartow counties, near Cartersville, Ga.

General News

Construction News.

ELBA, ALA.—The Pea River Power Company is reported to be preparing plans for the construction of a 3000-hp hydro-electric power plant. H. D. Boyd is secretary and treasurer.

GADSDEN, ALA.—Captain R. H. Cobb, of Anniston, Ala., has applied to the City Council for a franchise to erect transmission lines for the distribution of electricity in Anniston. He is interested in a project to construct a dam at lock No. 2 on the Coosa River, where it is expected to develop 25,000 hp to be distributed in Gadsden. Tentative contracts have been signed by the Southern Iron & Steel Company for 12,000 hp; and with the Dwight Manufacturing Company for 3000 hp.

MONTGOMERY, ALA.—The City Council has awarded contract for equipment for garbage disposal plant. Steam furnished from the disposal plant will be utilized to generate electricity.

SYLACAUGA, ALA.—It is reported that the city has postponed the date for receiving bids for equipment for the municipal electric light plant until June 2. Edgar B. Kay, of Tuscaloosa, Ala., is engineer.

TUCSON, ARIZ.—The plant and holdings of the Tucson Gas, Electric Light & Power Company have been purchased by a syndicate, headed by Sanderson & Porter, of New York, N. Y. It is understood that the electric plant and street railway system will be enlarged.

GRAVETTE, ARK.—The installation of a power unit is contemplated by E. F. Craven in the plant which he is building in Gravette, Ark.

BAKERSFIELD, CAL.—The Power, Transit & Light Company is contemplating making extensive additions and improvements to its Kern River power plant in the near future.

BODIE, CAL.—The Standard Consolidated Mining Company has applied to the Board of Supervisors for a 30-year franchise to erect and maintain transmission lines along certain roads and highways in Mono County for the distribution of electricity for lamps and motors. Bids for the above franchise will be received by the Board of Supervisors until July 6. George Delury is county clerk.

DIXON, CAL.—A deal is reported to have been consummated whereby the Pacific Gas & Electric Company has secured the electric light and water power properties of E. D. M. Lehe, of Dixon. The Pacific company proposes to develop plants and extend the lighting and water pumping services in the rural districts surrounding the towns in which the plants are located. Mr. Lehe owned the electric lighting plants and water supply stations at Wheatland, Lincoln, Davis, Roseville, Cordelia, Elmira, Winters, Dixon, Rio Vista and Benicia.

FOLSOM, CAL.—The Pacific Gas & Electric Company is reported to have purchased the electric plant and holdings owned by Isaac Hyman, in Folsom. Electricity for operating the local system is supplied by the Sacramento Electric, Gas & Railway Company under contract.

JOHNSVILLE, CAL.—Local parties are reported to be interested in the project to install an electric light plant on Jamison Creek, below Johnsville, for the purpose of furnishing electricity for commercial and residential lighting in this city.

LOS ANGELES, CAL.—The Sierra-San Joaquin Electric Company, recently incorporated with a capital stock of $5,000,000, for the purpose of developing power on the Tulare River, in Tulare County, will operate in connection with the Pacific Light & Power Corporation and the San Joaquin Light & Power Company in supplying electricity to the southern part of the San Joaquin Valley. The company has already spent about $800,000, and will expend $1,600,000 additional on the construction of dams and an 8000-hp plant, 25 miles above Porterville, from which the Kern and oil fields are to be furnished with electricity for lamps and motors. Maricopa and Taft will be the first towns served. W. G. Kerckhoff is president, Allan C. Balch, vice-president, and L. M. Farnham, secretary.

OAKLAND, CAL.—Surveys have been completed, and rights of way secured by the San Francisco, Oakland & San José Railway Company for its Key Route extension through East Oakland, Diamond, Allendale, Melrose Heights, Elmcrest and East San Leandro. Work on construction of the railway will begin as soon as franchises have been secured. The central power station will be located at Allendale.

VALLEJO, CAL.—The Board of Trustees has authorized the Board of Public Works to secure an engineer to prepare estimates of the cost of an electric plant to supply electricity for lamps and motors in this city.

WHITTIER, CAL.—The Board of Trustees has decided to engage an engineer to make a report of the cost of erecting plants to supply both electricity and gas.

BOULDER, COL.—Owing to the large demand for electricity for motors in the Boulder County mining field, L. P. Hammond, manager of the sales department of the Eastern Colorado Power Company, has established a general sales agent at the rooms of the Metal Mining Association rooms, in Boulder, to take charge of the business pertaining to transmission and motor equipment.

KERSEY, COL.—The Council has granted a franchise to W. F. Murphy, of Denver, Col., representing Eastern capitalists, to construct and operate an electric light plant and water-works system in Kersey.

JEWETT CITY, CONN.—The Borough Council has entered into a contract with the Nashawaug Electric Power Company to supply electricity to operate the municipal electric light system for a term of ten years. The company is building a plant at Plainville and is erecting a high-tension transmission line from Plainville to Jewett City. Electricity will be transmitted at 11,000 volts to the borough switchboard at Riverside.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company has transferred all its gas and electric lighting properties, owned or leased, to the Housatonic Power Company, which includes the lighting plants at Norwalk, South Norwalk, Greenwich, Naugatuck, Waterbury and New Britain, Conn. The Housatonic Company already owns the New Milford Power Company, which supplies electricity for the traction lines in Waterbury, New Britain, and other parts of Connecticut. The capital stock of the Housatonic Power Company has been increased from $1,000,000 to $3,000,000, the proceeds to be used to pay for the newly acquired properties, which will also provide for extensions and working capital. The new company was formed for the purpose of segregating the lighting and power companies from the electric railway companies owned by the New York, New Haven & Hartford Railroad Company.

WATERBURY, CONN.—The Board of Public Works has approved the new contract with the Connecticut Company for street lighting, by which the city will save $4,000 per year. Under the new contract the price for arc lamps will be reduced from $87.50 to $79 each per year. Incandescent lamps will be $20 each per year, same as before. The contract is for a period of five years, dating from March 1, 1910.

WATERBURY, CONN.—The contract for the construction of the new steam generating plant in Waterbury for the Connecticut Company has been awarded to Fred T. Ley & Co., of Springfield, Mass. The initial equipment will consist of two 1500-kw generators; provision will be made for installation of additional units as needed. The plant will be used to furnish electricity during the periods of low water at the New Miford Power Company's plant at Bulls Bridge on the Housatonic River. The cost of the plant is estimated at $150,000.

WILMINGTON, DEL.—The power plant of the Wilmington City Electric Company was badly damaged by fire May 24, causing a loss of about $50,000.

WASHINGTON, D. C.—The Capital Traction Company has purchased a large tract of land at the corner of Thirty-second and Water Streets, in Georgetown, on which, it is said, it will erect a new power house.

WASHINGTON, D. C.—Bids will be received until June 22 at the office of the supervising architect, Treasury Department, Washington, D. C., for furnishing and installing lighting fixtures in the United States buildings at Bridgeton, N. J.; Dothan, Ga.; Fernandina, Fla.; Gainesville, Fla.; Paris, Ill.; Portland, Maine; Sumter, S. C.; and Yazoo City, Miss., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 15 for furnishing and installing lighting fixtures in the United States post office buildings at Albuquerque, N. M.; Baker City, Ore.; Cheyenne, Wyo.; Kewanee, Ill.; Moline, Ill.; Ruston, La., and Sault Ste. Marie, Mich., in accordance with drawings and specifications, copies of which may be secured at the above office. James Knox Taylor is supervising architect.

TAMPA, FLA.—F. H. Richardson is reported to have applied to the City Council for a franchise to supply electricity for lamps and motors in Tampa.

ABBEVILLE, GA.—M. C. Paxson, of Abbeville, Ga., is reported to be in the market for a dynamo, small gasoline engine and two or three ceiling fans.

ATHENS, GA.—The State Railroad Commission has authorized the Athens Railway & Electric Company to issue $1,050,000 in capital stock and $825,000 in bonds. This company has been formed to take over the property and holdings of the old Athens Electric Railway.

AUGUSTA, GA.—The Augusta Railway & Electric Company is reported to be contemplating the installation of a 1000-kw steam turbine, with necessary boilers, etc. John H. Adams is chief engineer.

CARTERSVILLE, GA.—The property of the Etowah Power Company will be sold June 7 at the court house in Canton, Ga., by W. A. Carlisle, receiver. The holdings include all the property transferred to the Etowah Power Company by the Etowah Development Company by deed, May 25, 1905, and includes all the water power on the Etowah River, in Cherokee and Bartow counties, lying east and north of the Western and Atlantic railroad bridge, near this city, with rights to

flood and back water upon lands adjacent thereto. The property is sold under foreclosure of a mortgage by the Knickerbocker Trust Company, of New York, N. Y.

CLARKSVILLE, GA.—The Habersham Orchard & Improvement Company, recently incorporated, proposes to develop 1714 acres of land and to develop the water power of Soque River, to generate 1500 hp.

DALTON, GA.—The City Council has engaged H. S. Jaudon, of Savannah, Ga., to prepare plans and supervise the construction of the electric light plant and water works system and construction of sewerage system and paving, for which bonds to the amount of $95,000 were recently voted.

HAWKINSVILLE, GA.—The citizens have petitioned the City Council to call an election to vote on the proposition to issue $25,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant and water works system.

MACON, GA.—Announcement has been made that the Macon end of the Macon-Atlanta interurban electric railway has been financed and that definite plans will soon be announced. It is stated that work will commence on the proposed railway within the next 12 months.

MACON, GA.—The Central Georgia Power Company is reported to have awarded a contract to Wilder & Paullin, of Macon, Ga., for the construction of a substation in this city, the building and equipment to cost about $50,000. Contract for electrical equipment was awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. Electricity for operating the station will be brought from the hydroelectric power plant on the Ocmulgee River, near Jackson, Ga., at 66,000 volts.

BOISE, IDAHO.—The Snake River Irrigation Company is reported to have announced that plans have been completed for the Castle Butte project, located on the Snake River, 38 miles south of Boise, on which work will begin at once. The plan includes the construction of a power house and dam at a cost of about $500,000, with equipment capable of generating 10,000 hp, and irrigating 10,000 acres of fruit land. E. C. Crocker is vice-president and general manager.

CŒUR D'ALENE, IDAHO.—Preparations are being made by the Cœur d'Alene Indian Reservation Settlers' Association for the installation of an electric system, telephone lines, establishing schools, etc. William Masi, Jr., of Spokane, Wash., is president.

IDAHO FALLS, IDAHO.—Bonds to the amount of $95,000, which were recently voted by the City of Idaho Falls, for the construction of an electric light plant and water works system, have been sold. Bids are now being received for the construction of the plant. L. C. Kelsey, of Salt Lake City, Utah, is consulting engineer.

BELVIDERE, ILL.—Plans are being prepared by the Belvidere Screw & Machine Company, of Belvidere, Ill., recently incorporated, for the construction of a new factory building during the summer. It is said that a power plant will be installed and the machinery equipped for motor drive. It is understood that orders have been placed for most of the equipment.

CARTERVILLE, ILL.—Application has been made to the City Council for a franchise by the Egyptian Traction Company to construct and operate a street railway in Carterville.

CHICAGO, ILL.—The Interlocking Steel Form Company, 925 Unity Building, Chicago, Ill., is reported to be negotiating for a site for its proposed plant for the manufacture of steel tubes. The factory will be equipped for electric motor drive.

CHICAGO, ILL.—The Eastern Illinois Traction Company, a subsidiary of the Consolidated Railways Company, of Chicago, Ill., has secured franchises in West Hammond, Thornton Township, Blue Island, Riverdale and Harvey. It is understood that work on construction of the proposed railway will commence in the near future.

CHICAGO, ILL.—The contract for the construction of 12 buildings, including power house, pump house and car repair shop, for the Barrett Manufacturing Company has been let by Brill & Gardner, engineers and architects, 204 Dearborn St., Chicago, Ill. It is understood that part of the equipment has been provided for.

KANKAKEE, ILL.—The property and franchises of the Kankakee Electric Light Company and certain water power rights and water power development located in and near Kankakee, Ill., on the Kankakee River has been purchased by Kelsey, Brewer & Company, of Grand Rapids, Mich. It is proposed to consolidate these properties and organize a new company under the name of the Kankakee Power Company, under the laws of Delaware, to supply electricity in Kankakee and surrounding territory. The new owners, it is understood, propose to make considerable extensions and improvements to the property. The company has contracts for street lighting in Kankakee, Bradley and Bourbonnais.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company is reported to be contemplating the construction of an extension of its railway from Carbondale to Du Quion, Herrin, Carterville, Marion and Harrisburg. A. B. Newton is general manager.

NORTH CHICAGO, ILL.—Proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 14, for the construction of extensions to water mains, heating and electrical distributing mains, etc., and concrete conduit at the United States Naval Training Station, Great Lakes, North Chicago, Ill.

PLANO, ILL.—Preparations are being made by the Chicago Telephone Company for extensions and improvements to its local system, work on which will begin in the near future.

CRAWFORDSVILLE, IND.—The City Council has authorized the Board of Electric Light Trustees to engage an electrical engineer to take charge of the construction of the new municipal electric light plant. The cost of the new plant is estimated at $100,000. G. B. Luckett is chairman of board.

FORT WAYNE, IND.—The Board of Public Works has engaged John A. Radford, of Chicago, Ill., consulting engineer, to prepare plans for underground conduits in the down-town district for all electric and telephone wires.

INDIANAPOLIS, IND.—Preparations are being made by the Indianapolis Brewing Company for the installation of a 300-hp water-tube boiler at a cost of about $5,300.

JEFFERSONVILLE, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 1, for construction, including plumbing, gas piping, heating, electric conduits and wiring and lift of the United States post office, at Jeffersonville, Ind., in accordance with drawings and specifications, copies of which may be obtained at the above named office or from the custodian of site, at Jeffersonville, Ind. James Knox Taylor is supervising architect.

LOGANSPORT, IND.—Plans have been submitted to the Board of Public Works by the General Electric Company for the installation of a power plant for the purpose of pumping water to Hamilton Heights.

AUDUBON, IA.—The Audubon County Telephone Company has been granted a 25-year franchise in Audubon.

MASON CITY, IA.—It is reported that the Mason City & Clear Lake Railway Company is contemplating moving its principal power station from Emery to Mason City. The company is installing additional equipment in the local power house, which will increase the output of the plant by more than 50 per cent. New transmission lines are also being erected between Mason City and Clear Lake. F. J. Harrison is general manager.

MONTICELLO, IA.—Bids will be received until June 21 by the building committee, Board of Education, for the construction of a central power plant, also ventilating and heating system for a 10-room school and a high school in the independent school district of Monticello. Harry E. Netcolt, of Independence, Ia., is architect.

NEWTON, IA.—Bids will be received by Frank Sellman, county auditor, until June 9, for the installation of electric light fixtures in the new county court house.

FORT LEAVENWORTH, KAN.—Sealed bids will be received at the office of the constructing quartermaster, Fort Leavenworth, Kan., until June 9, for construction, plumbing, heating, electric wiring, and electric lighting fixtures of a building for quarters for four non-commissioned officers, and addition to fire department building. Full information and blank proposal furnished upon application. Plans and specifications may be seen at the above office; also in offices of chief quartermasters, at Denver, Col., St. Paul, Minn., and Omaha, Neb.; depot quartermaster, St. Louis, Mo., and quartermaster, Scarritt Arcade, Kansas City, Mo. Captain William D. Davis is constructing quartermaster.

NEWTON, KAN.—The Electric Light & Power Company is reported to be contemplating the installation of another unit, which will double the output of the plant.

GLASGOW, KY.—The Home Telephone Company, of Glasgow, Ky., has purchased the holdings of the Mutual Telephone Company, at Knob Lick. The Mutual Company has over 300 miles of telephone line in Monroe County.

ISLAND, KY.—The Memphis Mining Company is contemplating installing an electric power plant on its properties near Island, Ky. The equipment will include a 400-kw engine driven generating unit.

FARMINGTON, MAINE.—A new power house is being erected on the Carrabasset River, about three miles above North Anson, by C. O. Sturtevant, of Farmington. The plant will furnish electricity for lamps and motors in Farmington; transmission lines will be erected from the plant to this village, a distance of about 16 miles.

MT. WASHINGTON, MD.—The Mt. Washington Electric Light & Power Company has reduced its rates for electricity for lamps, to take effect from May 1. The price has been reduced from 20 cents per kw-hour with a discount of 25 per cent to 12 cents per kw-hour, with a discount of 2 per cent for all bills paid on or before the 10th of the month.

BOSTON, MASS.—The Boston & Eastern Electric Railroad Company has secured the approval of the Legislative Committee for the construction of its proposed electric railway from Beverly, Danvers and Boston. Contract for construction of the railways has been awarded to McArthur Brothers, of New York, N. Y.

MILFORD, MASS.—At a special town meeting, held recently, the citizens voted to authorize the Selectmen to enter into a contract for street lighting with the Milford Electric & Power Company and the Globe Gas Light Company for a term of three years.

SALEM, MASS.—The Salem Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $250,000 in additional capital stock, the proceeds to be used to pay floating indebtedness for new construction, extensions, and improvements.

SHELBURNE FALLS, MASS.—The State Board of Gas and Electric Light Commissioners has approved of an issue of 300 shares of new stock of the Shelburne Falls Electric Light & Power Company, par value $100 per share.

DETROIT, MICH.—The new plant of the Lozier Motor Company in Detroit, Mich., will be equipped for electric motor drive. Electricity for operating the works will be furnished by a 1000-hp electric power plant to be installed in connection with the new works.

DETROIT, MICH.—Preparations are being made by Dodge Brothers, of Detroit, Mich., for increasing the output of its power plant, the equipment to include two engine-driven alternators with a rating of 1200 kw, together with auxiliary machinery. It is understood that the contracts have already been placed for the equipment.

GRAND RAPIDS, MICH.—Plans are being prepared by the Luce Furniture Company, of Grand Rapids, Mich., for additions to its plant, with floor space 140 x 530 ft. The machinery will be equipped for electric motor drive.

STURGIS, MICH.—The City Council has awarded to the Allis-Chalmers Company, of Milwaukee, Wis., the contract for equipment for the proposed hydroelectric power plant to be erected on the St. Joseph River, at Lelands, where the city has secured options on a power site. The apparatus will include an 800-hp, single runner, vertical shaft turbine, designed to operate under a maximum head of 25 ft. The turbine will be direct connected to a 550-kva, 2300-volt, three-phase, 60-cycle, 150 r. p. m. alternator, a 40-kw, direct-current generator driven by a 67-hp, vertical shaft turbine, for excitation purposes; six 200-kva, 23,000-2300-volt transformers at each end of the line, and a three-panel switchboard The plant will be located 23 miles from Sturgis, and a transmission line will be erected to transmit electricity generated at the plant to this place.

FERGUS FALLS, MINN.—The City Light and Water Commission, it is said, will recommend improvements to the municipal electric lighting system.

MAZEPPA, MINN.—The question of making improvements to the municipal electric light plant is reported to be under consideration.

OWATONNA, MINN.—Application has been made to the City Council by A. L. Ober, of Chatfield, Minn., for an electric light franchise in Owatonna, Minn.

RED LAKE FALLS, MINN.—The plant and holdings of the Red Lake Falls Milling Company has been sold to the Red River Power Company. It is understood that improvements will be made to the property, including the raising of the dam and the installation of a 2500-hp plant.

ROBBINSDALE, MINN.—It is reported that the installation of an electric lighting system in Robbinsdale is under consideration.

ST. PAUL, MINN.—The Northern Heating & Electric Company, of St. Paul, Minn., is reported to be considering the installation of a motor generator set in its power station.

CLAYTON, MO.—Plans are being made by the St. Louis, Creve Cœur & Western Railway Company to begin work on its proposed electric railway to connect St. Louis, Creve Lake and intervening towns, 14 miles in length. Electricity for operating the railway will be purchased from the United Railways Company, of St. Louis. William F. Pfeister, Creve Cœur, Mo., is president of the St. Louis, Creve Cœur & Western Railway Company.

ST. LOUIS, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 27, for the installation of a conduit and electric wiring and gas piping system in the United States post office building at St. Louis, Mo., in accordance with drawings and specifications, copies of which may be had at the above office or at the office of superintendent of construction, at St. Louis, Mo. James Knox Taylor is supervising architect.

TIPTON, MO.—At an election held May 24 the proposition to issue $17,500 in bonds, the proceeds to be used for the installation of an electric light and power plant was carried. Joseph Sommerhauser is city clerk.

SHERIDAN, MONT.—It is reported that O. B. Preston, of St. Johns, Mich., is contemplating establishing an electric power plant in Sheridan.

CLAY CENTER, NEB.—It is reported that M. M. Johnson, owner of the electric light plant, is contemplating the construction of a new power house during the summer. A new generator will be installed.

COLUMBUS, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 11, for construction, including plumbing, gas piping, electric conduit, and wiring of the United States post office building at Columbus, Neb., in accordance with drawings and specifications, copies of which may be obtained from the custodian of the site at Columbus, Neb., or at the above office. James Knox Taylor is supervising architect.

O'NEILL, NEB.—The city is reported to be contemplating the installation of an electric light system during the summer.

RALSTON, NEB.—The Nebraska Traction & Power Company, which proposes to construct an electric railway from Ralston to Papillion, four miles in length, will erect a power plant and car barn in Ralston. W. D. Crist is general manager.

VALENTINE, NEB.—C. H. Cornell, of Valentine, Neb., is reported to be interested in a project to construct an interurban railway from Valentine to Spencer, via Pierre and Sioux City, a distance of 128 miles, for which rights of way are being secured. Power for operating the railway will be secured from the Niobrara River.

EAST TILTON, N. H.—The Stone & Webster Engineering Corporation, of Boston, Mass., has commenced work on the redevelopment of the water power property of the Laconia Gas & Electric Company, at East Tilton, N. H., consisting of the construction of a new concrete power station of 800 kw capacity, together with a seven-mile transmission line to Lakeport. Step-down apparatus will be installed at the company's plant in Lakeport. The present dam will be rebuilt, new headgates installed, and the canal widened at both ends.

RED BANK, N. J.—The Shaw Electric Company is reported to be constructing a new power plant in this city, at a cost of about $75,000.

BROOKLYN, N. Y.—Bids will be received until June 6 by C. B. J. Snyder, superintendent of schools, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., for completing and finishing electric equipment in Public School 162, on St. Nicholas Avenue, between Willoughby Avenue and Suydam Street, Borough of Brooklyn, in accordance with original plans and specifications of contract awarded to E. J. Duggan, which has been declared abandoned. Blank forms, original plans and specifications may be obtained at the above office and at branch office, 131 Livingston Street, Borough of Brooklyn, N. Y.

FULTON, N. Y.—The franchise granted by the Common Council recently for the distribution of electricity in Fulton will be sold to the highest bidder on June 17. Application for the franchise was made by the Niagara-Ontario Power Company.

NEWBURGH, N. Y.—The Public Service Commission, Second District, has granted the Orange County Traction Company permission to issue a mortgage for $750,000 on its property and franchises, to the Union Trust Company, of Albany, N. Y., as trustee, and to issue at once, $233,800 in bonds, to be sold at not less than 85, to pay off indebtedness for additions, improvements and equipment. The company is also authorized to issue $425,000 in bonds for refunding purposes, the exchange to be made at par.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of schools, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until June 6 for installing electric equipment in new Public School 77, Ridgewood Park, Borough of Queens. Blank forms, plans and specifications may be obtained or seen at above office and at branch office, 69 Broadway, Flushing, N. Y.

PLATTSBURG, N. Y.—Bids will be received at the office of the constructing quartermaster, Plattsburg Barracks, N. Y., until June 9, for construction of one four-set officers' quarters at Plattsburg Barracks, including plumbing, heating and electric wiring, and electrical fixtures. Plans and specifications may be seen at the above office and at the office of the chief quartermaster, Governor's Island, N. Y. Captain Edward T. Hartman is constructing quartermaster.

CARRINGTON, N. D.—We are informed that bids opened by C. W. Burnham, county auditor, for ventilating and heating apparatus, plumbing and electric wiring and conduits for telephones for the new county court house and jail have been rejected. New bids will be received by C. W. Burnham, county auditor, until June 24. Buechner & Orth, 601-2 Manhattan Building, St. Paul, Minn., are architects.

CINCINNATI, OHIO.—The Cincinnati Traction Company is reported to be contemplating extensive improvements to its system, which will involve an expenditure of about $1,500,000, and include the installation of new equipment and additions to power house and car houses. C. Burchmeyer is purchasing agent.

CLEVELAND, OHIO.—The General Traction Development Company, of Cleveland, Ohio, is contemplating the construction of a system of interurban railways in Ohio, connecting Mount Gilead, Mansfield, Mount Vernon, Delaware, Marion and Galion. Preliminary investigations are being made by Roberts & Abbott Company. The General Traction Development Company is also interested in an electric railway project in the Georgian Bay district of Canada.

CLEVELAND, OHIO.—Sealed proposals will be received by the Cuyahoga County Building Commission, 425 Garfield Building, Cleveland, Ohio, until June 29 for the construction and equipment of power plant, as follows: "A"—For construction of power house. "B"—For installation of equipment. "C"—Construction of tunnel. "D"—For installation of steam pipes and electrical cables connecting power plant with court house building. "E"—For construction and installation of condenser lines and equipment, in accordance with plans and specifications prepared by H. W. Woodward, Hollis French and Allen Hubbard, which are on file at the office of the commission. Proposal blanks covering the entire work can be secured on application to the clerk of the commission. Copies of specifications can be obtained of the clerk upon a deposit of $25. John J. Boyle is secretary pro tem of the Cuyahoga County Building Commission.

DELAWARE, OHIO.—Bids will be received by the Board of Trustees, Girls' Industrial Home, Delaware, Ohio, until June 27, for completing the lighting and heating system for the home. The specifications call for two additional engines and generators, 4500 ft. of steam heating conduit, 10-in., 6-in. and 4-in. mains, with 4-in., 3-in. and 2-in. returns. Reinforced concrete coal storage pocket, reinforced concrete electric lamp standards, 30,000 ft. of underground cable, wiring, lamps and fixtures for 12 buildings. Plans and specifications are on file at the office of Harold M. Bush, consulting engineer, 69 North Fourth Street, Columbus, Ohio. The total amount of appropriation is $70,000.

GREENVILLE, OHIO.—The Greenvile Electric Light & Power Company, is reported to be in the market for two new Corliss engine-driven generator units of 100-kw and 200-kw, together with auxiliary apparatus.

MAUMEE, OHIO.—The Phœnix Light & Power Company, which is developing a water power site, near Maumee, has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for the plant, consisting of two twin 26-in., horizontal, center discharge hydraulic turbines, enclosed in plate steel cylindrical casings, which will operate under an effective head of 61 feet. The turbines will be direct connected to two 937-kva, 2300-volt, three-phase, 60-cycle alternators, with direct connected exciters, each with a rating of 20 kw; also a 450-kva, 2300-volt, three-phase, 60-cycle, 240 r.p.m. generator to be connected to a turbine already installed. Excitation will be supplied by a 17-kw, 525 r.p.m. belted generator.

NEW CONCORD, OHIO.—The Village Council is reported to have awarded the contract for the construction of an electric light plant to Fairbanks & Morrison, of Columbus, Ohio, for $10,200.

CHEROKEE, OKLA.—It is reported that the city will call for bids in about 30 days for the construction of an electric light plant, and to complete the water works and sewer systems. The cost of the work is estimated at about $50,000.

JENNINGS, OKLA.—The construction of an interurban railway to connect Morrison, Glencoe, Stillwater and Perkins is under consideration, for which a bonus of $10,000 has been raised in Jennings. Surveys are now being made for the proposed railway. L. J. Lampke is interested in the project.

EUGENE, ORE.—The City Council is reported to have granted a franchise providing for the College Hill loop. The proposed extension will add about six miles to the present street railway system.

PORTLAND, ORE.—Arrangements are being made by the Doernbecher Manufacturing Company, of Portland, Ore., for the installation of a power plant to furnish electricity to operate its works. The equipment will include a 500-hp generator set, with exciter, switchboard and about 75 alternating-current motors.

PORTLAND, ORE.—Work will soon commence on construction of the new dam of the Portland Railway, Light & Power Company, contract for which has been awarded to the Puget Sound Bridge & Dredge Company, of Seattle, Wash. The dam will be located on the Clackmas River, about three miles below Cazadero. The cost of the plant, including dam is estimated at $325,000. The output of the plant will be about 25,000 hp. Plans are under consideration for the construction of another dam and power house three miles above Cazadero, to be built within a year.

CATASAUQUA, PA.—Sealed bids will be received by Albert B. Lee, secretary of Town Council, until June 13, for lighting various streets and alleys in the Borough of Catasauqua. Specifications and information can be obtained on application to R. H. Steinmetz, 126 Church Street, Catasaqua, Pa.

AIKEN, S. C.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 24, for construction of United States post office building, including plumbing, gas piping, electric conduits and wiring, in accordance with drawings and specifications, copies of which may be obtained at the above named office or from the custodian of site at Aiken, S. C. James Knox Taylor is supervising architect.

CHATTANOOGA, TENN.—Bids will be received by H. F. Van Dusen, chairman of Board of Public Works, Chattanooga, Tenn., for machinery for sewage pumping station, including two centrifugal pumps with electric motors, shaftings, etc. Specifications may be obtained on application to Robert Hooke, city engineer.

KNOXVILLE, TENN.—W. J. Oliver, of Knoxville, Tenn., has secured the contract to construct a 9000-hp plant on the Watauga River, eight miles above Elizabethtown. It is understood that an auxiliary steam plant will be erected in Bristol. The plant will furnish eectricity in Bristol, Johnson City and Elizabethtown.

STANTON, TENN.—The capital stock of the Stanton Telephone Company has been increased from $1,000 to $4,000.

TRENTON, TENN.—At an election held May 20 the citizens voted to issue $12,000 in bonds, the proceeds to be used to purchase the local electric light plant owned by Keenan & Wade. Extensions and improvements will be made to the plant, including the installation of new machinery.

ABILENE, TEX.—The Lanius Press Brick Company is reported to be contemplating the installation of an electric light plant.

BROWNSVILLE, TEX.—It is reported that plans are being made for extensions and improvements to the municipal electric light plant. M. C. Hanson is city engineer.

BRYAN, TEX.—The City Council has practically decided to install a municipal electric light plant, water works, and sewer system, at a cost of about $100,000.

WEBSTER, TEX.—It is reported that the Galveston-Houston Interurban Company has decided to locate its power plant on Clear Creek, in or near Webster, land for which has been donated by Robert E. C. Wilson.

GUNNISON, UTAH.—Plans are being prepared by the Gunnison Valley Power Company for the construction of a hydro-electric power plant, including distributing system.

PROVO, UTAH.—At an election held May 24, the citizens voted in favor of the proposition to issue $110,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, and $90,000 in bonds for water works improvements.

SALT LAKE CITY, UTAH.—The Davis County Independent Telephone Company has filed amendments to its charter, changing its name to the Home Telephone & Electric Company, and increasing its capital stock from $40,000 to $250,000.

BURLINGTON, VT.—Plans are being considered by the Burlington Light & Power Company for the construction of a large power plant at the Gorge. A 1000-kw steam turbine will be installed. The new building will be 30 x 90 ft., built of brick. It is also proposed to erect an auxiliary plant later at Essex Junction.

CREWE, VA.—J. Kent White, electrical engineer, of Waynesboro, Va., has been awarded the contract for the construction of the electric light plant in Crewe, Va.

WILLIAMSBURG, VA.—It is understood that Robert A. Conard, of Gordon & Conard, civil engineers, Maryland Building, Washington, D. C., will make application to the town authorities for a franchise for the installation of water, sewerage and electric light systems.

GOLDENDALE, WASH.—An option on the property of the Klickitat Light & Power Company is reported to have been taken by Fred Forrest. The power house is located on the Little Klickitat River, four miles east of Wahkiakus, on the railroad, and furnishes electricity for lamps in Goldendale and outlying districts. Surveys are now being made to secure an estimate of the undeveloped water power. The price placed on the plant is said to be $50,000. H. W. Fellows, of Goldendale, Wash., is owner of the plant.

NORTH YAKIMA, WASH.—A deed was filed May 14 transferring all the property of the Northwestern Corporation to the Yakima-Pasco Power Company. It is believed to be a subsidiary of the Columbia Light & Power Company, which was recently formed to take over the property of the Northwestern Corporation at Walla Walla. Announcement has been made that the Columbia Light & Power Company would erect a transmission line from North Yakima to Walla Walla, via Pendleton, to transmit electricity generated at Yakima Valley plant. It is expected that the plant of the Yakima Valley Power Company in the Naches, and the transmission line through the valley will also be taken over.

PE ELL, WASH.—It is reported that the plant of the Yeomans Lumber Company, of Pe Ell, Wash., has been destroyed by fire. It is expected that a new mill will be constructed at once, equipped for electrical operation.

RAYMOND WASH.—Application has been made to the City Council by P. E. Hall, Jr., president of the South Bend Electric Company, of South Bend, Wash., for a 45-year franchise to construct and operate a street railway system in Raymond, Wash.

REDMOND, WASH.—The Campbell Mill Company is reported to be planning to install a 150-kw belted electric generating set with motors and other power equipment.

RITZVILLE, WASH.—The Pacific Telephone Company is reported to have authorized improvements made to the local telephone exchange which will involve an expenditure of about $100,000.

SOUTH BEND, WASH.—The North Shore Light & Power Company is reported to have made application to the County Commissioners of Pacific County for a franchise to erect transmission lines for the distribution of electricity for lamps, heat and motors, also to erect telephone lines over certain roads in the county.

SPOKANE, WASH.—It is reported that the Local & Long Distance Telephone Company has authorized an issue of $500,000 in bonds, the proceeds to be used for the construction of telephone lines between Spokane and the coast cities, etc.

TACOMA, WASH.—The Tacoma Railway & Light Company is contemplating the construction of an electric railway to Bismarck. L. H. Bean is general manager.

TACOMA, WASH.—A franchise has been granted to the Sound Telephone Company to erect a telephone line from Tacoma to Long Branch, via Lake Bay, Glencove and McNeil's Island.

TACOMA, WASH.—The City Council is considering a proposition submitted by P. H. Webb offering to sell to the city, land and riparian rights located on the White River in the vicinity of Buckley, about 30 miles from Tacoma. It is estimated that 72,000 hp could be developed at a cost of about $2,246,970. It is not proposed to develop the power site at once, as the Nisqually power plant will be able to take care of the present demands. It is understood that W. C. Raleigh, city engineer, recommends the purchase.

WHEELING, W. VA.—The City & Elm Grove Railway Company has applied to the Council of Edgewood for a franchise to erect transmission lines to supply electricity for lamps through the town.

MARINETTE, WIS.—Mechanical equipment, including a large boiler, generator, motor driven fans and other apparatus, it is reported, will be required for a new public building in Marinette, Wis., of which Derrick Hubert, of Menominee, Mich., is architect.

MILWAUKEE, WIS.—The National Enameling & Stamping Company, it is reported, has decided to install a 200-kw alternating-current generator, with exciter, switchboard and controlling apparatus, to furnish electricity to operate the machinery in its plant.

MILWAUKEE, WIS.—It is reported that the Chicago & Wisconsin Valley Railroad Company will award contracts in the near future for the construction of its proposed railway from Janesville to Merrill. Allen T. Russell, of Chicago, Ill., is general manager.

PLYMOUTH, WIS.—The Plymouth Telephone Company has purchased the Wolf block, which it proposes to remodel for its exchange.

COQUITLAM, B. C., CAN.—Sealed tenders will be received by the Minister of Public Works, Victoria, B. C., Can., until June 6 for the construction of a transmission line for furnishing electricity for the Hospital for the Insane at Coquitlam. Plans, specifications, contract and forms of proposal may be seen at the offices of the Government agent at New Westminster; the Provincial timber inspector, Vancouver, and at the Department of Public Works, Victoria, B. C. F. C. Gamble is Public Works Engineer.

PORT ALBERNI, B. C., CAN.—A. E. Waterhouse, of Seattle, Wash., is reported to have filed notice of appropriation of 500 in. of water in Sproat River, with a view of establishing an electric power plant in Port Alberni.

PRINCE RUPERT, B. C., CAN.—Contracts are reported to have been awarded by James Milne, consulting engineer, for steam and electrical apparatus for the municipal electric light plants, as follows: For three return tubular boilers of 100 hp, pumps and piping to Goldie & McCulloch Company, of Galt, Ont., Can.; surface condenser, circulating and air pumps, to the John Inglis Company, of Toronto, Ont., Can.; two 175-kw alternators and arc lamp equipment to the Canadian General Electric Company, of Toronto, Ont., Can.; exciter and switchboard, to the Canada Westinghouse Company, of Hamilton, Ont., Can., and two 15 x 25 x 16 cross compound Robb engines, to the Robb Engineering Company, of Amherst, N. S., Can. The total cost of the plant is estimated at about $60,000.

VANCOUVER, B. C., CAN.—Contracts have been awarded by the British Columbia Electric Railway Company for part of the construction work of the new Barnaby Railway, work on which will begin soon. The proposed railway will be about 7¼ miles in length and will cost about $150,000.

VANCOUVER, B. C., CAN.—The contract for furnishing and erecting complete lamp standards for the ornamental lighting system, to be installed on Hastings, Georgia and Cordova Streets and Westminster Avenue, has been awarded to the Hinton Electric Company, of Vancouver, B. C., Can., for $46,908. The cost of installing the lamps will be paid by the property owners in the section where the lamps are erected. The city has agreed to maintain the standards and furnish electricity for the lamps.

PORTAGE LA PRAIRIE, MAN., CAN.—The City Council is considering a proposition submitted by C. Chamberlain, of the Great Falls Power Company, to furnish the city with a minimum of 2500 hp for a term of 30 years, the contract to take effect from January, 1912. It is said that the proposition will be accepted.

BROCKVILLE, ONT., CAN.—Mitchell & Mitchell are reported to have been engaged as consulting engineers in connection with the proposed improvements to the municipal electric light plant and water works system, for which $50,000 in bonds were recently voted.

HAMILTON, ONT., CAN.—Plans are being prepared by the Oliver Chilled Plow Works, of South Bend, Ind., for the construction of a new plant in Hamilton, Ont., Can., at a cost of about $1,500,000. All buildings will be of structural steel and concrete construction. A power house, 50 x 80 ft. and a boiler house of the same dimensions will be erected; an electric internal narrow gauge railroad system will be installed. Prack & Perrine, of South Bend, Ind., consulting engineers, have charge of plans for the plant. Richard A. Smart, of South Bend, Ind., will have charge of the new plant.

RENFREW, ONT., CAN.—At an election held recently the ratepayers voted to appropriate $117,000 to purchase water privileges and develop water-power on the Bonnechre River.

FRANCIS, SASK., CAN.—The Rural Telephone Company is asking for bids for the construction of a rural telephone system, consisting of about 16 miles of line. Colin Wells is secretary and treasurer.

LA TUQUE, QUE., CAN.—The municipality, it is reported, is contemplating the installation of a municipal electric light plant, at a cost of about $50,000.

MONTREAL, QUE., CAN.—The Canadian Pacific Railroad Company is reported to be considering equipping its terminals in Montreal for electrical operation.

WATERVILLE, QUE., CAN.—It is reported that plans have been completed for a water power development on the Coaticook River, about one mile below Waterville. The proposed plant will furnish electricity for lamps in Waterville and Compton, and also 250 hp to operate the factory of George Gale & Sons. F. C. Davis, who has charge of the Hydro-Electric plant for the Town of Coaticook, is engineer.

CANANEA, SONORA, MEX.—The Cananea Consolidated Copper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for six six-hearth McDougall furnaces for its reduction and concentration works in Cananea.

New Industrial Companies.

THE ALLIED INDUSTRIES COMPANY, of Newark, N. J., has filed articles of incorporation, with a capital stock of $550,000, as general contractors to construct railroads, bridges, etc. The incorporators are: W. W. Wilson, of Rockland, N. Y.; D. T. Gately, of Brooklyn, N. Y., and N. G. Wells, of Penn Yann, N. Y.

THE BALDWIN MOTOR SERVICE COMPANY, of Hackensack, N. J., has been incorporated with a capital stock of $250,000 by T. H. Baldwin, of Hackensack, N. J.; F. Kaegbehn, of Brooklyn, N. Y., and G. C. Norwood, of New York, N. Y. The company proposes to manufacture and deal in automobiles.

THE COHEN-RATTINER COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $6,000, to manufacture and deal in gas and electric fixtures. The incorporators are: Marcus Rattiner, 3905 Third Avenue, Brooklyn, N. Y.; Samuel Cohen, Max Rosenberg and others, all of Brooklyn, N. Y.

THE CONCRETE ENGINEERING COMPANY, of Boston, Mass., has been chartered, with a capital stock of $25,000, for the purpose of doing a general building and construction business. The officers are: William M. Bailery, of Malden, Mass., president; Henry W. Nutt, 11 Park Street, Brookline, Mass., treasurer, and Chester J. Hogue, of Quincy, Mass., clerk.

THE ELECTRIC SPECIALTY COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by R. L. Palmer, Edward Younger, H. J. Palmer, T. R. Tease and W. K. Caldwell.

THE ELECTRICAL UTILITIES COMPANY has filed articles of incorporation, with a capital stock of $125,000. The incorporators are: G. W. Dorsey, George W. May and John Seller, of Wilmington, Del.

THE FALCON MOTOR CAR MANUFACTURING COMPANY, of Camden, N. J., has been incorporated by Frank A. Kuntz, Joseph P. Murray and William S. Kell, of Camden, N. J. The company is capitalized at $125,000, and proposes to manufacture automobiles, motor cars, etc.; also to do a mechanical engineering business.

THE HASTINGS MOTOR SHAFT COMPANY, of Hastings, Mich., has been incorporated, with a capital stock of $30,000, for the purpose of manufacturing solid camshafts, crankshafts and motor specialties.

THE HYDRO-TELE-MOTOR COMPANY, of New York, N. Y., has been chartered, with a capital stock of $25,000, by Herbert F. Fisher, 134 West 126th Street, New York, N. Y.; Joseph W. McKay, of Brooklyn, N. Y., and E. Edward Cole, of Hoboken, N. J. The company proposes to manufacture and deal in power transmission machinery.

THE KENYON ELECTRICAL MANUFACTURING COMPANY, of Kenyon, Mich., has been chartered, with a capital stock of $125,000, by August Jensen, Martin Hjermstad, and others. The company proposes to manufacture electrical carrier systems, motors, batteries, etc.

THE MECHANICAL APPLIANCES & POWER COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $300,000. The incorporators are: John C. Renter, Byron A. Eldred, and Frank G. Silver, of New York, N. Y.

THE MOORE LIGHT COMPANY, of New York, N. Y., has been incorporated by R. A. Greene, of Passaic, N. J.; W. R. Smith, I. Honigman and J. J. Brennan, of New York, N. Y. The company is capitalized at $400,000, and proposes to do a general electrical and mechanical engineering and contracting business.

MULTICOLOR ELECTRIC SIGN COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $250,000, for the purpose of manufacturing and dealing in electric and gas advertising devices and signs. The incorporators are: S. Brown, H. W. Deitrich and G. W. Study, all of New York, N. Y.

THE MOHICAN MANUFACTURING COMPANY, of Richmond, N. Y., has been chartered by T. L. Dennis, of Prince Bay, N. Y.; L. A. Essner, of Tottenville, N. Y. and F. H. Smith, of Humphrey. The company is capitalized at $50,000, and proposes to manufacture and deal in automobiles, motor cycles, airships, motor boats, engines, etc.

THE PHILLIPS AUTOMATIC AIR-BRAKE COUPLER COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $1,000,000. The incorporators are: S. E. Roberson, H. W. Davis, of Wilmington, Del., and others.

THE SEARS CROSS COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $30,000, to deal in automobile and motor supplies and accessories; manufacture and deal in speed controlling and recording devices for automobiles and motor vehicles. The incorporators are: P. Muller, of Brooklyn, N. Y.; E. S. Gallatly, of New York, N. Y., and W. F. Kendall, of West Haverstraw, N. Y.

THE SHAW-HARRISON GAS ENGINE COMPANY, of Stockton, Cal., has been chartered, with a capital stock of $250,000, by James Shaw, A. J. Harting, A. F. and W. H. Harrison.

THE STILLMAN SAFETY LAMP COMPANY, of New York, N. Y., has been chartered by J. W. Potter, V. M. Bovic and F. P. Wilson, all of New York, N. Y. The company is capitalized at $200,000, and proposes to manufacture safety lamps and apparatus for same.

THE THERBER GAS ENGINE COMPANY, of Butler, Ind., has been incorporated with a capital stock of $20,000 for the purpose of manufacturing gas engines, transmission and lighting plants and automobiles.

The directors are: Henry M. Showalter, D. A. Barker, Frank Greager and J. G. Wagoner.

THE TROJAN CONSTRUCTION COMPANY, of Troy, N. Y., has been incorporated, with a capital stock of $10,000, for the purpose of doing a general building and construction business. The incorporators are: Royden L. Holt, Charles W. Morris, Jr., and Clark Cipperly, all of Troy, N. Y.

THE TWOMBLY MOTORS COMPANY, of New York, N. Y., has been chartered, with a capital stock of $1,000,000, for the purpose of manufacturing motors and motor vehicles of all kinds. The incorporators are: D. Stuart Dodge, Harry F. McGarvie, W. Irving Twombly, of New York, N. Y.

THE UNIVERSAL LUBRICATOR COMPANY has filed articles of incorporation with the Secretary of State, with a capital stock of $250,000. The incorporators are: John S. Collins, Jr., W. F. P. Lofland and W. I. N. Lofland, of Dover, Del.

THE UNIVERSAL STANDARD ELECTRIC COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The company proposes to manufacture and deal in all kinds of electrical machinery and appliances, etc. The incorporators are: J. J. Nevins, W. H. Hobart and A. Schreiber, all of Brooklyn, N. Y.

New Incorporations.

LITTLE ROCK, ARK.—Articles of incorporation have been filed for the Little Missouri River Power Company, by O. B. Guthrie, W. V. Thompkin, L. P. Beidleman, T. C. McRae, H. E. Bemis, W. N. Bemis and M. W. Greeson. The company is capitalized at $100,000, and proposes to establish a power plant near Murfreesboro, Ark., in Pike County, for the purpose of developing water power on Little Missouri River. M. W. Greeson is president of the company.

COIN, IA.—The Coin Electric Light & Power Company has been incorporated, with a capital stock of $10,000, by C. S. Buchtel, F. J. Whitmore, William Davison, Charles Hart and S. C. Manifield.

HAMMOND, LA.—The Hammond Interurban Railway Company has been formed, with a capital stock of $1,000,000, for the purpose of building an electric railway in Hammond. The directors are: L. D. Spencer, B. H. Brooks, T. W. Cate, D. H. Taylor, B. M. Morrison and E. R. Moore.

DETROIT, MICH.—The Grosse Isle Railway Company has been organized to construct an electric railway around the islands in Detroit. Frank Whitehall and P. N. Jacobsen are interested in the company.

OSBORN, MONT.—Articles of incorporation have been filed for the Riverside Telephone Company, by E. H. Hyder, J. H. Walker, A. A. Knowe and Harry K. Cohen. The company is capitalized at $10,000, and proposes to erect and operate a local telephone system.

HANNIBAL, N. Y.—The Hannibal Electric Company has been chartered, with a capital stock of $20,000, for the purpose of generating and selling electricity, etc. The incorporators are: Theodore P. Ball, Ernest W. Rice and Charles A. Cox, of Hannibal, N. Y., and others.

WAYNE, N. Y.—The Wayne Telephone Company has filed articles of incorporation, with a capital stock of $250,000. The incorporators are: W. P. Rogers, of Williamson, N. Y.; H. P. McDonough, of Newark, N. Y., and F. D. Gaylord, of Sodus, N. Y.

MIDDLESEX, N. C.—The Merchants Telephone Company has been incorporated, with a capital stock of $10,000, to construct and operate a telephone system between Middlesex and Wilson. The incorporators are: S. C. Wells, of Wilson, N. B. High, of Middlesex, N. C., and others.

LOMA, N. D.—Articles of incorporation have been filed for the Gordon Farmers' Telephone Company, with a capital stock of $7,000, by John Watz, Fred Heimbecker, A. J. Lunde, all of Loma, N. D., and others.

CINCINNATI, OHIO.—The Cincinnati Terminal Railway Company has been incorporated for the purpose of building a union depot and terminals for steam and interurban railroads entering Cincinnati, at a cost of about $30,000,000. The officers of the company are: Archibald S. White, president; John E. Bleekman, vice-president and general manager, and F. R. Williams, secretary and treasurer, all of Cincinnati, Ohio.

ENID, OKLA.—The Enid Electric & Gas Company has been chartered, with a capital stock of $3,000,000, by John F. Curran, Lincoln Beerbower, Isaac Milkvitch, Lewis W. Fitch and S. Danforth.

COMMERCE, TEX.—The Commerce Power Company has been chartered, with a capital stock of $10,000, by J. H. Watley, J. H. Rush, S. G. Duff and F. M. Kemp.

DALLAS, TEX.—The Trinity Valley Traction Company has been organized for the purpose of constructing an electric railway to connect Waxachie, Dallas, Corsicana and Palestine, a distance of 119 miles. J. V. Watkins, of Dallas, is president.

ROCK SPRINGS, TEX.—Articles of incorporation have been filed for the Rock Springs Telephone Company, with a capital stock of $15,000, by A. C. Schreiner, D. H. Comparette, S. H. Gilmer and others.

CHARLOTTESVILLE, VA.—The Palmyra Telephone Company has been incorporated with a capital stock of $10,000. The officers of the company are: G. E. Walker, president; W. D. Bacon, vice-president, and F. W. Tyman, secretary and treasurer.

ROMNEY, W. VA.—The Moorefield & Virginia Railway Company has been chartered for the purpose of building an electric railway from Moorefield to Hardy, a distance of about 20 miles. The officers of the company are: William B. Cornwell, of Romney, president; C. B. Welton, of Moorefield, vice-president; Eugene W. Ailes, of Washington, D. C., secretary and treasurer, and William Trapnell, of Romney, general manager and chief engineer.

ROSBY'S ROCK, W. VA.—The Tri-District Telephone Company has been incorporated, with a capital stock of $10,000, by R. G. Dakam, of Rosby's Rock, W. Va.; R. C. Yoho, of Moundsville, W. Va., and others.

Personal.

MR. HAYDEN EAMES, general manager of the Studebaker Automobile Company, is a graduate of the U. S. Naval Academy, class of 1882. While on ordnance duty at Hartford he became interested in the electric vehicle, and in 1894, resigned his commission as ensign in order to join the Pope organization, at that place, in a technical capacity. Later he was engaged for several years on special work with the Westinghouse interests at Pittsburgh in connection with the development of the electric truck, on the conclusion of which he entered the automobile business on his own account at Cleveland. Several years ago he joined the Studebaker Company at South Bend. For ten years or more, Mr. Eames has been an ardent advocate of the electric commercial vehicle, and in season and out, has urged its claims for recognition. His latest contribution to the subject was a paper read last week at the St. Louis National Electric Light Convention, entitled, "The Electric Vehicle Opportunity."

Hayden Eames.

PROF. B. HOPKINSON and *MR. F. SODDY* have been elected Fellows of the Royal Society, London.

MR. E. N. SANDERSON, of the firm of Sanderson & Porter, New York, is making a business tour in the West.

MR. W. S. BARSTOW, president of W. S. Barstow & Company, of New York, has returned from a trip to Portland and the West.

MR. F. C. LORING, formerly instructor of electrical engineering at Cornell University, is now connected with the Metropolitan Street Railway Company of New York.

MR. GUY W. TALBOT, vice-president and general manager of the Oregon Electric Railway Company, has been elected president of the Portland Gas & Coke Company, Portland, Ore.

MR. D. M. COUGHLIN, formerly with the Easton Gas & Electric Company, Easton, Pa., has taken charge of the commercial department of the Spokane Gas Company, of Spokane, Wash.

MR. W. E. HASKINS, superintendent of the Williamantic Gas & Electric Company, has also been appointed superintendent for the entire system of the Rockville-Willimantic Lighting Company.

MR. H. WARD LEONARD will sail on June 4 for an extended tour abroad, where he and his wife, together with some friends, intend to spend several months motoring in England, France, Switzerland and Germany.

MR. R. W. CLARK, assistant commercial agent of the Minneapolis General Electric Company, delivered a lecture May 18 before the electrical engineering students of the University of Minnesota, entitled "Residence Lighting."

MR. R. E. STODDARD who has been active superintendent of the Whitman division of the Edison Electric Illuminating Company, of Brockton, Mass., has resigned and will be succeeded by Mr. Walter Small, of Lowell, Mass.

MR. LESTER McKINNEY has resigned from the engineering staff of the Boston office of the General Electric Company, to accept the position of electrical engineer of the Garner Print Works and Bleachery, Wappinger Falls, New York.

MR. WILLIAM MORGAN LEWIS, manager and chief engineer of the Rockville (Conn.) Gas & Electric Company and of the Stafford Springs Electric Light & Gas Company, has been selected as manager of the Willimantic Gas & Electric Company and will have control of all three concerns. Mr. Lewis will continue to make his home in Rockville.

MR. M. ABRAHAMSON, of the firm of Tvermoes & Abrahamson, Copenhagen, Denmark, is in this country with a view to securing for his

firm agencies from manufacturers of American electrical goods of all descriptions. Mr. Abrahamson may be addressed at the office of Melchoir, Armstrong & Dessan, export and commission merchants, 116 Broad St., New York.

PROF. A. S. RICHEY, head of the electric railway engineering department of the Worcester Polytechnic Institute. has been engaged by the Boston & Northern and Old Colony Street Railway Co. to make a scientific study of schedules for the purpose of determining the most economical speeds, headways, and sizes of cars for their various divisions. All of these divisions comprise about 950 miles of track.

MR. ARTHUR WILLIAMS, of the New York Edison Company, will sail from New York on the North German Lloyd steamship, George Washington, on June 9, for a ten weeks tour of Europe. It is his intention to employ his motor car throughout the trip, which will include all the centers of commercial and industrial activity on the continent. Mr. Williams is deeply interested in some of the sociological problems of the day, and will attend a number of meetings in Paris, Berlin, London, and Vienna, where matters of this kind will be discussed. He will make, besides, individual studies, and hopes to gather valuable information which may be of service to his company, and also to the electric lighting industry.

Obituary.

MR. ALFRED JOHN GREATHEAD, who has been connected with John A. Roebling's Sons Company for 23 years, and who had been secretary of the company for the past 5 years, died at his home, 5645 Calumet Avenue, Chicago, on May 21, at the age of 49. He was born on May 5, 1861, at Barnstaple, England. Mr. Greathead was a member of Kenwood Lodge, No. 800, A. F. & A. M., Fairview Chapter 161, Royal Arch Masons; Montjoie Commandery 53, Knights Templar. He leaves a widow and three daughters.

PROF. GEORGE FREDERICK BARKER, emeritus professor of physics at the University of Pennsylvania, died May 25 at Philadelphia. Professor Parker was born in Charlestown, Mass., and was graduated from Sheffield Scientific School at Yale in 1858. Previous to taking the physics chair at Pennsylvania in 1873 he held positions in Harvard Medical School, Wheaton College, Western University and Yale Medical School. Professor Barker was first to exhibit radium in this country (1899). He pointed out its economical advantages over x-rays for surgical diagnosis. Professor Barker received the degree of Bachelor of Philosophy from Sheffield, that of Doctor of Medicine from Albany, Doctor of Science from the University of Pennsylvania and Doctor of Laws from Allegheny College and McGill University. He was United States Commissioner to the Paris Electrical Exhibition in 1881, delegate to the electrical congress and vice-president of the jury of award, receiving the decoration of the Legion of Honor of France. In 1884 he was United States Commissioner to the Electrical Exhibition in Philadelphia. He was on the jury of awards at the World's Columbian Exposition in 1893. He acted as an expert in the Edison, Berliner and other patent suits.

Trade Publications.

SMALL PUMPING OUTFIT.—Bulletin 322A, of the Holtzer-Cabot Electric Company, Brookline, Mass., gives data and price of direct current and alternating current, 0.5-hp rotary pumping set.

BUFFERS.—Motors equipped with spindles for carrying buffing and grinding tools are described in Bulletin 3707 of the Emerson Electric Manufacturing Company, St. Louis, Mo. Operating data and prices are given.

WASHINGTON MACHINE MOTORS.—Direct current and alternating current motors of 0.1 hp for driving family washing machines are described in Bulletin 3962 of the Emerson Electric Manufacturing Company, St. Louis, Mo.

ELECTRIC FANS.—The Pettingell-Andrews Company, Boston, Mass., has just issued a very attractive bulletin on motor fans. The fans are described, illustrated and data given, which covers the dimensions, weight, price, speed, emf, etc.

SIROCCO TURBINE FAN.—The American Blower Company, Detroit, Mich., has issued Bulletin No. 283, having for its subject the "Sirocco" turbine type fan. Full details of the fan are given, with numerous illustrations.

SMALL SINGLE-PHASE MOTORS.—Bulletin 3138, of the Emerson Electric Manufacturing Company, St. Louis, Mo., describes and gives data and prices of a line of single-phase induction motors, ranging in size between 1/8 and 1/5 hp.

ELECTRIC FIRELESS COOKER.—The Electric Fireless Cookstove Company, of Hastings, Mich., has issued Bulletin No. 5, which sets forth the good points of the fireless electric cooker and gives a cost comparison with gas and other fuels.

ENGINE-GENERATOR UNITS.—The construction of revolving field type alternators for direct connection to high-speed engines is described and well illustrated in Bulletin No. 24 of the Ridgway Dynamo & Engine Company, of Ridgway, Pa.

SHADES AND REFLECTORS.—The Macbeth-Evans Glass Company, of Pittsburgh, Pa., has issued an attractive catalog, in which a great variety of glassware is illustrated with dimensions. The catalog is No. 38. It is bound in cloth, and contains 128 pages, 4½ in.x 8 in.

AIR BRAKES.—The National Brake and Electric Company, of Milwaukee, Wis., has just issued Bulletin 389, describing in detail the construction and operation of its emergency and variable release valves. Complete piping diagrams are shown for motor and trail car equipments.

SMALL TRANSFORMERS.—A line of small transformers for ratings from 0.5 kw up to 50 kw are advertised in a 6-page folder of the Duncan Electric Manufacturing Company, Lafayette, Ind. The data given includes core loss, copper loss, exciting current, weight, gallons of oil, etc. Prices are also given.

SMALL DIRECT CURRENT MOTORS.—A line of bipolar, shunt and compound motors, made by the Emerson Electric Manufacturing Company, St. Louis, Mo., is described in its Bulletin 3217. The construction is discussed in detail, and tables of technical data and prices are given. The sizes listed range between 0.05 and 0.25 hp.

ELECTRIC DRIVE AND CEMENT PLANTS.—The rapid increase in the use of concrete has necessitated a corresponding increase in the manufacture of Portland cement. Bulletin No. 4722 of the General Electric Company enters more or less into the details of electric drive in connection with the manufacture of this material.

SMALL DIRECT CURRENT MOTORS AND GENERATORS.—The construction of a line of small direct current machines is described and sets of performance curves shown in Bulletin 317A, of the Holtzer-Cabot Electric Company, Brookline, Mass. This bulletin also contains a list of the bulletins issued by the motor department.

MOTOR FANS.—A booklet entitled "Making Hot Weather Delightful," is issued by the Fort Wayne Electric Works, Fort Wayne, Ind. The booklet illustrates, describes and gives list prices and various data concerning an extensive line of motor fans. Both alternating current and direct current motors are being built for the fans, and both kinds of motors may be had with three speeds.

DIRECT-CURRENT, WATT-HOUR METERS.—In Bulletin No. 4721 of the General Electric Company direct-current, watt-hour meters are illustrated and described. The meters are equipped with an adjustable shunt field coil which causes the meter to register correctly on light load, regardless of vibration and variation of potential and without affecting full load accuracy. These meters are made for two or three-wire service.

KNIFE SWITCHES.—Catalog 20 of the Barkelew Electric Manufacturing Company, Middletown, Ohio, gives detailed instructions for ordering and list price tables for switches up 2000 amperes rating. The different types are illustrated, and the book gives a pleasing impression, due to use of brown ink on india tint paper. Among the types shown there, are switches designed to carry fuses, so as to replace the switch blade.

FAN MOTORS.—Bulletin No. 4719 of the General Electric Company describes its fan motors and small power motors for the season of 1910. This publication illustrates and describes fans suitable for use in the home, office, or public building, for installation on a desk, table, wall floor or ceiling, and for use in telephone booths. It lists also fans for ventilating purposes, and illustrates small power motors for both domestic and commercial use.

ASBESTOS ROOFING.—The H. W. Johns-Manville Company has issued a folder describing a pliable roofing material made by impregnating asbestos fibers with asphalt. The materials all came from the company's mines. This material is made in rolls and can be nailed on like paper. Containing, as it does, only mineral the material is fireproof and permanent. The following advantages are claimed: Permanent, fireproof, light weight, does not require painting, is a good insulator of heat.

DEFLECTOLIER.—A booklet is being distributed by Edward J. O'Beirne & Co., Elgin, Ill., in which reasons are given to show why the central station manager should interest himself in the introduction of the deflectolier. The deflectolier uses five tungsten lamps, and is designed to utilize the light as coming from a single source of considerable radiating surface. An important argument in its favor, as compared with the arc for indoor illumination, is that the central station is entirely relieved of the maintenance of the lamps.

HIGH-PRESSURE PACKING.—A comprehensive line of metallic and combination metal and fiber packing for use in high-pressure piping and machines is listed in a tactful catalog issued by the American Goetze-Gasket & Packing Company, of New Brunswick, N. J. Corrugated copper in various special shapes is used by this company in building packing which will be able to stand up under high pressure and temperature. The copper is sometimes used alone and other times it is used as reinforcement and protection for some fibrous materials, such as asbestos.

SMALL DIRECT-CURRENT MACHINES.—A line of small direct-current machines which embodies a number of distinct design features is described and illustrated in Bulletin 106 of the Engineering Electric Manufacturing Company, Stamford, Conn. The armature is mounted in a cradle which carries the bearings, brushes and slips into the frame, being secured to one end of the frame. This arrangement enables ready inspection of all the moving parts. Another feature is the shaft, which is not built into the armature, but may be slipped out and substituted by one of any desired length. The bulletin describes motors, generators, motor-generators and dynamotors ranging in size from 0.05 to 1.0 hp.

AIR-ELECTRIC DRILL.—The Economic Machinery Company, of Denver, Col., has issued a book describing a reciprocating drill which is operated by electricity through an elastic cushion of air. The motor drives a reciprocating piston which fits in a cylinder within a cylinder, the intermediate cylinder being capable of a reciprocating motion and closed at both ends. When the piston moves away from the work it compresses air in one end of the closed cylinder and carries it along storing energy in its mass, and when the piston starts back toward the work the cylinder continues in the same direction, transferring its stored energy to air compressed in the front end of the piston. This pressure quickly reverses the piston and adds to the effect of the forward motion of the piston, thus delivering the complete energy of the revolution, less friction losses, to the drill head.

BUSINESS NOTES.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, Chicago, has opened a New York office at 1138 Broadway. Mr. C. F. Ziegler is in charge.

THE ALBERGER CONDENSER COMPANY and the Alberger Pump Company announce the removal of their offices to the West Street Building, 140 Cedar Street, New York.

THE DEARBORN DRUG & CHEMICAL WORKS has moved its laboratory and offices from the Postal Telegraph Building to the McCormick Building, Michigan Avenue and Van Buren Street, Chicago.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY, formerly the Lincoln Motor Works Company, Cleveland, Ohio, announces that hereafter its armature shifting type of variable speed motor will be known as the Reliance adjustable speed motor, instead of the Lincoln variable speed motor as formerly. This change is stated to be necessary better to describe this type of motor in accordance with present standard terms adopted by the American Association of Electric Motor Manufacturers, and also to avoid confusion with the product of the Lincoln Electric Company, of Cleveland.

TRIUMPH SALES.—The Triumph Electric Company, Cincinnati, during the past three weeks has received orders for the following apparatus: One 300-kw alternator and 30 alternating-current motors, aggregating 450 hp, from Massachusetts; one 300-kw direct-current generator, California; two 150-kw direct-current generators, Michigan and Ohio; three 75-kw generators, Ohio; seven 75-kw direct-current generators, Michigan and Minnesota; two 50-kw direct-current generators, Ohio; six 50-kw direct-current generators, Ohio, Kentucky, Mississippi and Pennsylvania; one 35-kw direct-current generator, Virginia; seven alternating and 28 direct-current motors, Ohio. The new Triumph shops are three times the size of the former shops and equipped with the latest types of labor-saving machinery, which enables the increasing business to be handled promptly.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Jefferson, N. H., June 27-30, 1910.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Independent Telephone Asociation of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Davenport, Ia., April, 1911.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. SECRETARY, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting on board steamer *Queen*, leaving Seattle Aug. 26, 1910.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEGRAPH ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York. Next meeting, Cooperstown, N. Y., June 27 and 28, 1910.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Lena M. Owen, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WASHINGTON ELECTRICAL SHOW, October or November, 1910.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WINNIPEG ELECTRICAL SHOW, Winnipeg, Manitoba, July 13 to 23, 1910.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 24, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

958,719. SIGNAL BOX FOR FIRE-ALARM SYSTEMS; F. S. Bronson, Rochester, N. Y. App. filed Dec. 13, 1909. Fire-alarm and automatic telephone in which the signaling apparatus actuates the central telephone to automatically select the fire-alarm headquarters and then ring the number of the box.

958,727. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. Includes a cup, lamp shell metal ring terminal clip screw center contact washer and insulating button.

958,728. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. An insulating ring with threaded shells having clips through the ring.

958,729. CLUSTER LAMP SOCKET; J. H. Dale, New York, N. Y. App. filed May 6, 1908. A casing with holes receiving bushings having beaded portions outside the casing and sheet-metal coatings covering the beads.

958,744. TROLLEY WHEEL HOLDER AND GUIDE; W. A. Gunn and L. W. Link, Cincinnati, Ohio. App. filed Sept. 10, 1908. Finder for trolley wheels having two arms to embrace the wire which drop when meeting an obstruction.

958,753. ELECTRIC CAUTERY; W. Meyer, Chicago, Ill. App. filed Sept. 13, 1909. Two leads insulated, but rigidly united with an incandescent conductor and a coating of heat resistance material applied to the ends of the leads near the conductor.

958,754. HIGH-FREQUENCY MAGNETO; T. M. Mueller, New York, N. Y. App. filed Aug. 4, 1908. Magneto with slotted cylindrical inductor, stationary and adjustable pole pieces, the inductor having a portion successively passing all the poles.

958,755. PUSH-BUTTON SWITCH; A. S. Muller and L. E. Carrico, Denver, Col. App. filed May 17, 1909. A push-button switch for making and breaking the circuit by actuating a ratchet and cam.

958,757. ELECTRIC MELTING AND REFINING FURNACE; H. Nathusius, Friedenshutte, near Morgenroth, Germany. App. filed May 7, 1908. A hearth, electrodes therein, with means for varying the density of the current along the respective paths.

958,788. MAGNETIC SWITCH; J. J. Wood, Fort Wayne, Ind. App. filed Sept. 29, 1905. Controlled from a distance and including pivoted levers carrying movable contacts with a solenoid electromagnet between them and toggle links.

958,792. ELECTRICAL MEASURING INSTRUMENT; J. L. Zander, Newark, N. J. App. filed May 21, 1909. For measuring heat by means of a pair of magnets a straight and arc-shaped pole member and a wire-wound coil encircling the latter and moving thereon.

958,803. CONTROLLER; F. D. Hallock, Pittsburgh, Pa. App. filed Sept. 8, 1908. A face plate controller with a plurality of stationary contacts, a rotatable contact arm, a spring for returning it to off position and an electromagnet for locking the spring.

958,804. MOTOR STARTER; F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate rheostat controller with pivoted contact arm automatically thrown to the off position, the contact arm being independent of the operating lever except when current is supplied to the motor.

958,805. RHEOSTATIC CONTROLLER FOR ELECTRIC MOTORS; Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate controller having two pivoted arms with an electrical, instead of a mechanical, interlock, one arm carrying an electromagnet governing the position of the other arm.

958,806. REGULATING RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate rheostat controller having a pair of contact bearing arms with means for retracting one to off position, for latching the two together, a handle for operating both arms and for releasing one and operating it separately.

358,808. FUSED DISTRIBUTING BOARD AND CROSS-CONNECTING RACK; R. G. Hardgrave, Tucumcari, New Mexico. App. filed May 3, 1909. For telephone system for connecting from a street cable the telephone switchboards, having street cable connections on one side, switchboard connections on the opposite side and interchangeable wires extending between them.

958,827. ELECTRIC ARC LAMP; L. W. Pullen, Camden, N. J. App. filed Dec. 12, 1905. A reservoir containing mercury surrounded by an electromagnetic solenoid; a plunger float in the reservoir which moves and regulates the carbon.

958,828. ARC LAMP; L. W. Pullen, Camden, N. J. App. filed May 24, 1906. A central tube, non-magnetic, a surrounding solenoid, a magnetic head upon the tube above and below and the magnetic plunger within the tube for operating the carbon.

958,829. METHOD AND APPARATUS FOR PRODUCING HIGH-FREQUENCY OSCILLATING CURRENTS; J. H. Rogers, Hyattsville, Md. App. filed Jan. 20, 1910. Regulates the discharge of the condenser between electrodes by feeding a small body of liquids of

low conductivity between the electrodes to unbalance conductivity and resistance.

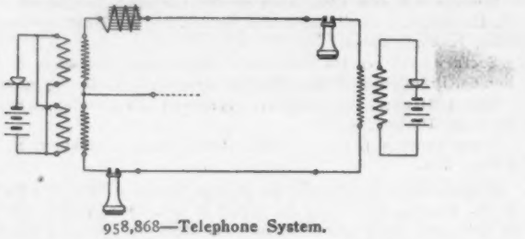
958,833. TROLLEY CONDUCTOR CLAMP; W. Schaake, Pittsburgh, Pa. App. filed Nov. 19, 1908. A pair of duplicate members with projecting shanks and intermediate interlocks which can be separated to force the jaws together.

958,834. HANGER FOR ELECTRICAL CONDUCTORS; W. Schaake, Pittsburgh, Pa. App. filed July 28, 1909. For gripping a suspended conductor by means of two complementary gripping members with outwardly projecting complementary bosses having inclined surfaces, caps for the bosses and a bolt for drawing the caps together.

958,846. ELECTRICAL WATER HEATER; H. D. Wood, Jr. Minneapolis, Minn. App. filed April 8, 1909. For heating water for soda fountains having a water delivery conduit with an electrical conductor extending within and longitudinally of the conduit.

958,855. ELECTRIC FURNACE; H. A. Danne, Clarksburg, W. Va. App. filed Jan. 12, 1910. A circular electrode of downwardly increasing diameter and a plurality of rings of electrodes surrounding it, each group being disposed in different horizontal plane.

958,856. TELEPHONE SYSTEM; W. W. Dean, Elyria, Ohio. App. filed Oct. 14, 1909. For signaling between the parties on a trunking



958,868—Telephone System.

system, including a supervisory relay, a low-resistance relay and a high non-inductive resistance in the shunt circuit, the latter preventing the operating of the supervisory relay and being cut out when the called subscriber responds.

958,863. PARTY LINE CALL REGISTER FOR AUTOMATIC TELEPHONE SYSTEMS; A. H. Dyson, Chicago, Ill. App. filed June 20, 1908. The adjustment indicates the initiating station and is then put beyond the control of the calling party for recording.

958,868. TELEPHONE SYSTEM; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed Feb. 1, 1908. The phase relation of the currents during their transmission over the lines is altered to improve the speech.

958,869. RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed July 6, 1908. For starting and governing electric motors by means of a pivoted rheostat arm on the plate with detailed specific construction.

958,870. STARTING RHEOSTAT; F. D. Hallock, Pittsburgh, Pa. App. filed July 6, 1908. Overload starting rheostat of the plates and swinging arm type, including a concentrically pivoted arm which operates the resistance governing arm with a third arm interrupting the connection between the two on overload.

958,894. PARTY LINE TELEPHONE SYSTEM; H. J. Roberts, Evanston, Ill. App. filed May 1, 1905. Selective signaling, secrecy and lockout system employing magnet relays, instead of step-by-step mechanism.

958,809. SPARK COIL; C. H. Thordarson, Chicago, Ill. App. filed Sept. 3, 1907. Has a laminated core, side pieces at the end and channel clips engaging the ends and side pieces.

958,906. EAR FOR TROLLEY WIRES; J. H. Callender, Brooklyn, N. Y. App. filed June 14, 1907. A single casting with a flat flange bent to shape to form the groove.

958,925. TELEPHONE SET; W. Kaisling, Chicago, Ill. App. filed Aug. 1, 1908. Wall set, including a back plate, a hinged containing box, an impulse controlling device, a sliding cover and catch for locking the cover.

958,979. TELEPHONE SWITCH HOOK; B. W. Sweet, Cleveland, Ohio. App. filed Sept. 20, 1909. The supporting hook is removably held and actuates springs in the base of the instrument by means of a depending portion of a pivoted bell crank member actuated by the hook.

958,988. PULL SOCKET FOR ELECTRIC SWITCHES; F. Barr, New York, N. Y. App. filed Nov. 12, 1909. Details in a pole switch in which a spindle is rotated by the pulling cord actuating a ratchet to operate the contact.

959,005. REGULATING RHEOSTAT FOR ELECTRIC MOTORS, F. D. Hallock, Pittsburgh, Pa. App. filed Jan. 3, 1910. Face plate rheostat having field and armature contacts, pair of contact arms and adjustable means for restricting the independent adjustment of one of the arms relative to the other.

959,032. ELECTRICAL SELF-PLAYING ATTACHMENT FOR PIANOS; I. B. Smith, Philadelphia, Pa. App. filed May 19, 1905. Electromagnetic means are arranged within the piano for controlling the connections between the hammers and a shoe in the roller.

959,045. ELECTRIC ARC LAMP; H. Beck, Frankfort-on-the-Main, Germany. App. filed Nov. 14, 1906. Carbon holder, the electrode support being frustum-shaped, having an eccentric projection for removably securing it to the carrier.

959,052. INSULATOR AND CONDUCTOR FOR ELECTRIC CURRENTS; A. Champion, Flint, Mich. App. filed Nov. 3, 1908. Insulating conduit carrying conductors in its walls serving as a container for another conductor.

959,073. RELAY AIR VALVE; H. J. Richardson, Chicago, Ill. App. filed Jan. 30, 1908. Relay air valve operated by electromagnet.

959,075. METAL FILAMENT LAMP; C. Rumenapp, Augsburg, Germany. App. filed March 20, 1909. Has alternately long and short current distribution wires.

959,076. TROLLEY WIRE HANGER; J. T. Scanlon, Hartford, Conn. App. filed Sept. 30, 1909. The body has a throat to receive the wire with recesses on the body and opposite sides of the throat opening in opposite directions.

959,100. AERIAL CONDUCTOR ARRANGEMENT FOR WIRELESS TELEGRAPHY; G. Von Arco, Berlin, Germany. App. filed Nov. 1, 1906. A central conducting support insulated from ground, such as a tower and an umbrella-shaped group of wires running toward the ground, connected at one end of the support and the other to ground.

959,120. LIGHTNING ARRESTER; W. W. Dean, Elyria, Ohio. App. filed April 26, 1909. Two sheets of finely divided conducting material are separated by an insulator.

959,133. ARC LAMP ELECTRODE; J. H. Hallberg, New York, N. Y. App. filed April 26, 1907. A cored electrode of carbon with an external longitudinal rib and having a longitudinal conductor in the electrode.

959,171. ELECTRIC CIRCUIT BREAKER; W. H. Scott, Norwich, England. App. filed Dec. 23, 1907. A relay circuit breaker whose circuit is automatically broken on overload with electromagnetic means in connection with a movable switch member for forcibly opening the main switch.

959,192. STORAGE BATTERY; V. G. Apple, Dayton, Ohio. App. filed Dec. 21, 1908. Two plate grid electrodes having tapered ribs crossing at right angles with a perforated plate forming the bottom of the cells.

959,193. ANNUNCIATOR DROP; C. Auth, New York, N. Y. App. filed July 7, 1908. An electromagnet, frame, shaft on the frame and a target carried by the shaft beyond the bearing.

959,194. ANNUNCIATOR DROP; C. Auth, New York, N. Y. App. filed March 5, 1909. An electromagnet, a core, a movable armature and an adjustable plate limiting the movement.

959,197. OVERHEAD CONTACT SYSTEM FOR ELECTRIC RAILWAYS; J. Belzner, Jr. App. filed Jan. 5, 1909. A contact rail on the top of the car, a contact brush or an arm of a pole and means for connecting the brush and a spring actuated conductor and switch with the feed-wire.

959,215. ELECTRIC HEATING DEVICE; R. L. Hailey, New York, N. Y. App. filed March 9, 1909. A flattened zigzag wire, all portions of which lie in the same horizontal plane, is clamped to a radiating plate.

959,227. APPARATUS FOR REMOVING TARNISH FROM METALS; M. H. Keyt, Chicago, Ill. App. filed Feb. 2, 1910. A receptacle, a removable article support therein, each non-corrodible, and a removable metallic member forming the anode, for contact with the article.

959,243. DESK TELEPHONE STANDARD; C. T. Mason, Sumter, S. C. App. filed Oct. 20, 1909. A tubular base and transmitter support in one structure with a hook mechanism insertable in the top of the base.

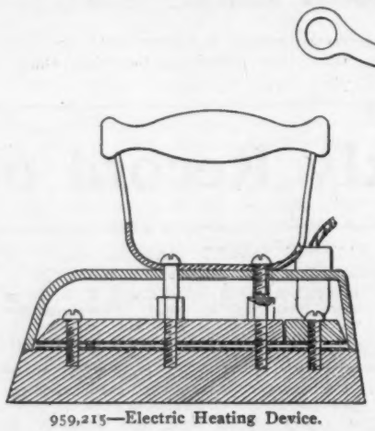
959,248. ELECTRIC SWITCH; J. F. McElroy, Albany, N. Y. App. filed Sept. 16, 1909. For electric car heaters on car platforms operated by the door by means of a push-button and an automatic lock.

959,257. ELECTRICALLY ACTUATED SWITCH; F. G. Proutt, Memphis, Tenn. App. filed Nov. 30, 1908. A switch blade pivoted, its center of gravity with an arc-shaped slot above, a solenoid and a core working in the slot for cutting out the arc lamp at a predetermined time.

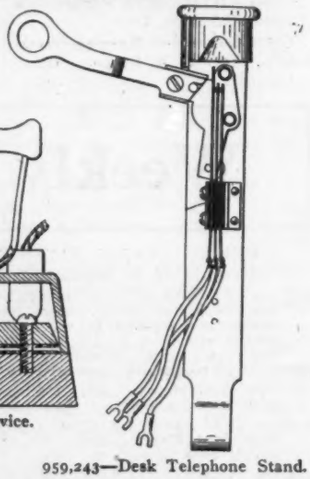
959,303. INSULATOR FOR BATTERY PLATES; C. J. Bristol, Des Moines, Ia. App. filed Sept. 27, 1909. A notched bar with locking strip for separating storage battery plates.

959,305. ELECTRIC WELDING MACHINE; A. E. Buchenberg, Toledo, Ohio. App. filed Sept. 25, 1909. A work holding chuck and a reciprocating arm carrying a removable socketed work holding part in register with the chuck.

959,337. TRANSMISSION OF ELECTRICAL ENERGY; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed Dec. 20, 1905. For alternating currents in which the lines are in inductive relation and one of them contains an impedance and an



959,215—Electric Heating Device.



959,243—Desk Telephone Stand.

insurging line is in inductive relation to both lines, the impedance and surging line altering the normal phase relation in one line relative to the other. For telephony and electric signaling.

959,371. ELECTRIC SIGN; L. Miller; Brownwood, Tex. App. filed Jan. 18, 1909. A flashing device for electric signs, consisting of a rocking frame actuated by an electromagnet which throws a ball acting as a circuit closer against a number of contacts. The ball in turn controls the electromagnet to rock the frame.

959,399. ELECTRIC HEATERS; G. E. Stevens, Lynn, Mass. App. filed Sept. 25, 1908. An electric heater comprising a resilient heating element and a member for closing the circuit thereto moved by the element. The conductor is a spiral metal spring one end fixed and the other end carrying a contact moved by the pressure of the water in the pipe into engagement with the fixed contact so as to close the circuit.

959,428. METHOD OF TRANSMITTING ELECTRICAL ENERGY; W. F. Gradolph, St. Louis, Mo., and W. C. Hahne, Chicago, Ill. App. filed April 7, 1910. Generates an alternating current and delivers it to a circuit, alters the phase relation of the two sides of the circuit near the generator and restores the phase relation near the receiving end.

959,435. CIRCUIT CLOSER; H. C. Thomson, Boston, Mass. App. filed March 6, 1909. Push-button switch in which the plunger carries a cam which expands a helical spiral spring surrounding it so as to close the circuit between the spring and suitable contacts.